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MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME II

WITH 11 PLATES

1914

ST. LOUIS, MISSOURI

PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:

ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

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MISSOURI BOTANICAL GARDEN BULLETIN

Vol. II JANUARY, 1914 No. 1

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BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
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EDWARD C. ELIOT.

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Chancellor of Washington University.

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Mayor of the City of St. Louis.

EDWARD A. RAITHEL,
President of the Board of Public Schools of St. Louis.

DANIEL S. TUTTLE,
Bishop of the Diocese of Missouri.

A. D. CUNNINGHAM, Secretary.

Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., January, 1914 No. 1

REPORT OF THE OFFICERS OF THE BOARD

SUBMITTED TO THE TRUSTEES, JANUARY 14, 1914.

To the Board of Trustees of the Missouri Botanical Garden:

We submit for your consideration the financial results for the year ending December, 1913.

Our income from rentals exceeded that of the previous year by $1,264.32, although four pieces of income property were disposed of early in the year. Never since the foundation of the Trust have we had so few vacancies and at present only three small pieces, with an aggregate monthly rental of $57.00, are unoccupied.

As nearly all of our most valuable properties are under lease for long terms, we cannot hope for any further increase in our rental income for several years.

During the year we disposed of several pieces of central income property as follows:

Nos. 503-4-5-11 North Levee	100 feet for	. .	$ 30,000 00
No. 608 Olive Street	21 feet for	. .	164,000 00

The latter being under lease for a term of ninety-nine years, its value was, to a certain extent, fixed for that time and it was sold on a basis of four and one-half per cent, with the intention of reinvesting the proceeds of both pieces in property bringing a higher rate of income.

We have been very successful in disposing of the tract known as the Lafayette Avenue Addition, comprising a frontage, between Grand Avenue and Lawrence Street, of 11,533 feet, 9,771 feet of which have already been sold and largely improved with a good class of residences, flats and apartments. As the prices obtained have been satisfactory we hope to improve the balance of the tract—containing about 11,860 front feet—in the near future.

Our sales of vacant residence property during the year are as follows:

Lafayette Avenue Addition	2,147 feet	$82,668 08
Flora Boulevard Addition	210 feet	15,160 00

We recently purchased from the Board of Education for $12,000 a triangular piece of ground, containing three-fourths of an acre, fronting 162 feet on Kingshighway and 60 feet on Vandeventer Avenue, upon which is located the old Shaw School building—now unfit for use as a school. This was done in order to ultimately make possible the extension of the Garden tract to Kingshighway and to prevent, in the meantime, the erection of undesirable structures. The ground was sold to the School Board by Mr. Shaw in 1858 for the sum of $609.42.

Expenditures for streets and sewers have been very heavy, as is shown by the following payments made during the year:

City Block No. 4940	Alley	$ 1,326 47
Shaw Avenue	Street and sidewalk	20,316 02
McRee Avenue	Sidewalk	1,640 10
Arsenal Street	Sidewalk	945 28
Kingshighway	Area Tax	2,049 18
Sewers		37,778 04
		$64,055 09

Large sums have been expended upon the Garden for its care and for special and unusual permanent improvements, as will be seen by the statement of exenditures for garden improvements, amounting in all to $100,059.34—the principal item being the new plant house recently completed, costing $152,147.01, of which sum $97,436.00 was paid in 1912, and $54,710.56 in 1913.

Additions to the Library and Herbarium by purchase and gift during the year have amounted to the following sums:

Library	$2,904 90
Herbarium	4,029 60

Two of the annual bequests provided for in Mr. Shaw's will have been carried out in full—the Annual Flower Sermon and the Gardeners' Banquet. As no flower show was held in St. Louis, $300.00 was offered as premiums at the International Flower Show held in New York last spring.

We have charged the Missouri Botanical Garden and credited to Property Account the following expenditures for permanent improvements:

New Plant House	$152,147 01
Director's New Residence	26,140 70
New Stone and Iron Fence	6,523 21
	$184,810 92

Your attention is called to the following statement of receipts and disbursements:

RECEIPTS.

Rentals	$158,429 29	
Interest and Dividends	9,926 88	
Garden Handbook Sales	231 00	
Publication Sales	7 26	
Garden Sales of Material and Pasturage	140 85	
Total Income Receipts		$168,735 28
Sales of Real Estate Under Decree	$72,688 72	
Sales of Real Estate, Account of Endowment	74,000 00	
Notes Receivable	42,054 50	
Shaw School of Botany, Rentals	3,900 00	
Insurance From Loss by Fire	106 63	
Sales of Real Estate, Monthly Contracts	875 00	193,624 85
Total Receipts		$362,360 13
Cash Balance December 31st, 1912		690 81
		$363,050 94

DISBURSEMENTS.

Garden Account—			
Labor Pay-roll	$28,869 59		
Students' Pay-roll	1,902 52		
Open Sunday Pay-roll	313 00		
Office Assistance	1,125 20	$32,210 31	
Fuel	4,351 82		
Water	1,385 40		
Repairs and Supplies	4,633 92		
Stable and Implements	1,095 51		
Plants and Seeds	2,894 29		
Total for care of Garden			$46,571 25
Herbarium Account—			
Salaries	$4,389 14		
Current Expense and Additions	2,063 96		6,453 10
Library Account—			
Salaries	2,678 14		
Current Expense and Additions	2,376 67		5,054 81
Garden Office Account—			
Salaries	$7,524 96		
Current Expense	1,855 26		9,380 22
Research and Instruction—			
Salaries	$9,043 74		
Current Expense and Instruments	2,236 88		11,280 62
Total Garden Maintenance			$78,740 00

Garden Improvements—		
New Plant House	$54,710 56	
New Service Road	1,357 25	
Director's New Residence	25,440 70	
New Stone and Iron Fence	6,523 21	
General Improvements	12,027 62	100,059 34
Total Amount Expended on Garden		$178,799 34
Property Account—		
State, School and City Taxes	$33,717 75	
Sprinkling Taxes	1,527 41	
Streets, Sidewalks and Sewers	66,368 09	
Insurance	4,949 61	
Repairs	8,460 97	
Improvements	550 00	115,573 83
Publication Account—		
Twenty-third Annual Report	$1,117 21	
Twenty-fourth Annual Report (partial)	1,692 16	2,809 37
Bequests—		
Annual Flower Sermon	$200 00	
Annual Gardeners' Banquet	413 25	
Annual Flower Show	300 00	913 25
Sundries—		
Office Expense	$6,365 05	
Legal and Professional Services	535 43	
Commissions	8,689 30	
Repairs to Building Damaged by Fire	106 63	
Washington University	430 31	
Shaw School of Botany, Rentals	4,676 85	20,803 57
Investments—		
Extension to Garden, Old Shaw School	$12,000 00	
Bank Certificates of Deposit	16,420 78	28,420 78
Total Disbursements		$347,320 14
Cash Balance, December 31st, 1913		15,730 80
		$363,050 94

Respectfully submitted,

EDWARDS WHITAKER, President.

Attest:

A. D. CUNNINGHAM, Secretary.

TWENTY-FIFTH ANNUAL REPORT OF THE DIRECTOR

SUBMITTED TO THE BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN, JANUARY 14, 1914

Gentlemen:

I have the honor to submit herewith the Twenty-fifth Annual Report of the Director.

The year 1913 has been an eventful one for the Missouri Botanical Garden. Perhaps never before in its history have so many important projects been inaugurated or completed within twelve months. While the new range of greenhouses naturally comes first to mind, a large number of other improvements and additions, some of which are of even greater significance than the new conservatories, combine to make the year such a one as will be difficult to duplicate in the future.

The publication of a monthly bulletin; a start towards a change in plan of the main garden, harmonizing it with the new greenhouses; the erection of a new residence for the Director; the completion of the stone wall and fence along Tower Grove Avenue, as well as the construction of a permanent iron fence along Magnolia and Alfred Avenues; the inauguration of monthly floral displays; the changes in the old greenhouses which have made possible the more successful growing of orchids, pitcher plants, etc.; the beginning of a thorough and comprehensive botanical survey of the Southwest; the addition to the staff of Dr. J. M. Greenman as Curator of the Herbarium, and Dr. E. A. Burt as Mycologist and Librarian, as well as the gratifying number of graduate students from all parts of the country, indicating the increasing recognition of the unexcelled facilities to be found at the Garden, are a few of the year's events which are calculated to make the Missouri Botanical Garden better known and of greater service to the public and the scientific world at large. A significant fact in this connection is the appreciation of some of these changes by the citizens of St. Louis and the out-of-town visitors, as evidenced by the

fact that the attendance during 1913 was more than double that of 1911 and far exceeded that of any year in the history of the Garden, with the single exception of the World's Fair year.

MAIN GARDEN

The location of the new conservatories is such that it dominates all that part of the Garden in view from the main gate; consequently, it became necessary to alter the old arrangement of these grounds in order that they might properly conform to the new range, as well as to the old houses still standing. The necessary removal of the old stone wall that formerly bounded the west side of the main garden also made it desirable that this part of the Garden be entirely remade; accordingly, early in the spring the large area south of what was formerly the parterre, was transformed from a formal into a natural garden. This involved not only the construction of over 3,500 feet of new walks but also the elimination of all the old ones. In place of the flat plane with its myriads of small beds and maze of walks, there was substituted a rolling landscape covered with shrubbery and flowers with long stretches of lawn, broken in one place by a small stream and its accompanying pools. An effort was made to break up the landscape so as to frame with small knolls the particular object to be seen, having it appear at the end of a valley. From the main gate to the entrance of the new greenhouses the treatment has been formal in order that a path as direct as possible might be established to the conservatory. In about the same position as the old parterre and occupying approximately an equal area, is the new water garden, which, during the summer, contained a profusion of water lilies and other aquatic plants. While the extremely hot and dry season was not favorable for the satisfactory growth of the new lawns and the immense number of transplanted trees and shrubs, it is believed that by next spring things will have become sufficiently established to present the desired appearance.

HERBACEOUS GROUNDS

This area, which for many years has been devoted to a collection of species representing various botanical families, was completely remodeled and proved to be one of the most attractive parts of the Garden. Including, as it did, a collection of farm crops and unusual economic plants as well as illustrations of special features, such as a back yard vegetable garden, a grandmother's garden, window boxes, border plants, annual climbers, savory and medicinal herbs,

hardy perennials for private place planting, etc., it contained something which appealed to a variety of tastes.

ROSE GARDEN

No one feature of the out-of-door planting has been so attractive throughout the entire season as the collection of roses. The popular belief that these plants, both on account of the climate and the soil, cannot successfully be grown in St. Louis has been completely disproved. From early in June until frost there was a most creditable display of blossoms and the opportunity to see here a large number of the new varieties of roses has been much appreciated by the public. Succeeding years will see this garden increase in beauty and attractiveness.

FLORAL DISPLAYS

Although the new greenhouses were not completed until late in the summer of 1913, it was possible during the previous winter and spring months to show a considerable number of flowering plants in the north wing. In January, azaleas, cyclamens, callas, cinerarias, primulas, begonias and other plants were exhibited. A group of lilacs, hawthorns and crabapples, forced by the ether and hot water method, attracted considerable attention. During February, 1,500 Chinese primroses were the predominating feature, accompanied by a large collection of azaleas, cyclamens and spiraeas. In March and the early part of April probably the largest and most interesting collection of bulbs ever displayed under glass in St. Louis was exhibited. This included some 10,000 tulips (about 90 varieties), 700 hyacinths (85 varieties), 500 plants of the Easter lily, 100 calla lilies and hundreds of narcissus, including about 50 special varieties, many of which had never before been shown in this country. The exhibit attracted wide interest among dealers and growers in the vicinity of St. Louis, and visitors came from Chicago, Cincinnati, Indianapolis, Kansas City and many intermediate points, to have an opportunity of seeing the rarer sorts of bloom. During April and May a particularly fine collection of new French hybrid hydrangeas was displayed; also about 500 roses, comprising the finest of the hybrid perpetuals, hybrid teas and polyanthas. Potted dwarf fruit trees in flower, including apple, cherry, pear, peach and nectarines, which had been trained into pyramid, gridiron and fan shapes, forming an interesting part of the May display. In addition, some 300 tobacco hybrids in red, purple, pink, and white, a large number of

hybrid gloxinias, as well as calceolarias, blue daisies, marguerites, and various other flowering plants, were shown. In the latter part of May, and extending into June, the chief floral display was that of tuberous begonias which, because of their extraordinary size, color and variety, excited much favorable comment. During the summer, when attractive displays could be made out of doors, no attempt was made to show flowering plants in any large number in the greenhouses.

With the opening of the new plant range in November occurred the usual chrysanthemum display which was notable on account of the new seedlings shown, as well as the exhibit of what could be done with this plant in training it into formal designs. This exhibit was followed in December by a large number of poinsettias, peppers, begonias, and other plants showing the Christmas colors.

NEW PLANT RANGE

The new range of greenhouses for which ground was broken early in April, 1912, was completed at the end of June, 1913. Since the plan of this house called for the setting of the plants directly in the soil, it was necessary to fill the house with suitable earth, about 3,000 yards being required for this purpose. The tall central house was planted with palms and the arrangement is such as to enable the visitor to view with ease the large number of unusual and attractive specimens. The north end of the main range has been devoted to the ferns and the plan, which includes a grotto and deep valley through which a small stream runs, makes it possible to exhibit these plants in a way that is new and attractive. The south end of the range is devoted to economic plants and here the visitor may have the opportunity of seeing many unusual tropical fruits, medicinal, fibre, perfume, and other plants used in commerce. The two wings of the new house are reserved for the various floral displays. The houses were opened for the first time to the public on Sunday, November 16, when over 10,000 people visited the Garden between the hours of two and five.

CHANGES IN THE OLD GREENHOUSES.

Most of the valuable plants from the old front range, which, because of its unsafe condition, has been closed to the public, have been removed to the new conservatories. This old range affords, however, valuable storage space for roots of caladium, canna, mallow and other plants. The cycads were removed

to the new greenhouse and the space formerly allotted to these plants has been devoted to the orchids. The new location is much better adapted to the orchids and consequently the collection has been considerably augmented during the year, particularly in increasing the number of plants of certain varieties, as well as in securing new species not hitherto represented in the collection. The old fern dome has been transformed into a banana house where there are now some eight varieties, including two interesting plants grown from seed. The West Indian house has been entirely rearranged, as well as the bromeliad house, while the old orchid house has, by the addition of a large pool, been transformed into a place particularly well adapted to the nepenthes and other insectivorous plants. Many of the larger plants have been removed to the new conservatory from the Linnaean house, the latter being temporarily closed. However, it is the ultimate intention to arrange in this house a collection of citrus fruits, when it will again be open to the public.

ADDITIONAL IMPROVEMENTS

Ground was broken in the southeast corner of the Garden for a new residence for the Director on the 11th of December, 1912, and the house is now about ready for occupancy.

The publication of a monthly bulletin was begun in January and has been a decided success. The demand is steadily increasing and, aside from its announced purpose of keeping the people in the vicinity of St. Louis informed as to what is going on at the Garden, it seems to have become recognized as of distinct educational value. Requests from schools, both in the city and elsewhere, for extra copies of certain numbers, are not infrequent, and extracts from the BULLETIN have appeared in the daily press all over the country, as well as in various weekly and monthly publications.

Changes and improvements too numerous to mention have been made in the old greenhouses and growing houses. Much attention has been paid to painting and repair work and these houses are now in as good condition as possible without spending on them more money than they are worth. A number of concrete, steam-heated cold frames have been constructed which are a decided addition to the propagating space and make it possible to provide the rapidly increasing number of plants required to supply the various floral displays. A new house was constructed just back of the Linnaean house which provides growing space as well as furnishing for the first time an adequate storage space

for bulbs and plants which have to be held over. There has also been built a new shed for flower pots, which enables all the various sizes to be kept separate and an accurate account of the stock on hand or in use is now available.

Large quantities of new shrubs and trees have been planted in the main garden and elsewhere which, within a few years, will become a prominent part of the improved planting scheme towards which we are working.

The construction of the central heating plant necessitated a new road for the hauling of coal and, consequently, a properly constructed service road from Shaw Avenue to the boiler house has been built.

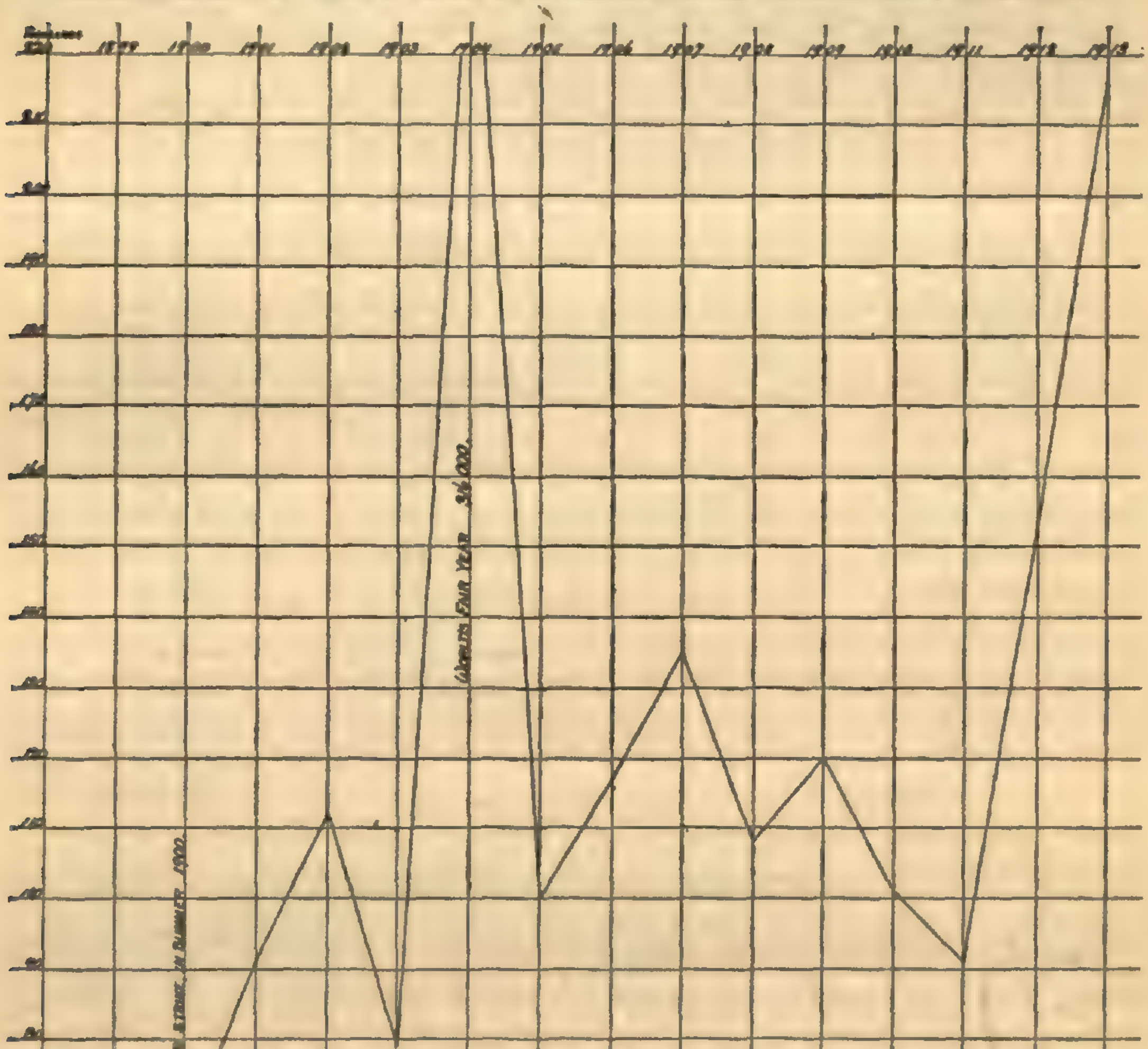
Not one of the least of the improvements during the year was the completion of the stone wall and fence along Tower Grove Avenue and Alfred Avenue. Aside from the improvement in appearance, this fence has been a very distinct factor in enabling us to control the depredations and misconduct of irresponsible parties who formerly were able to get into the North American Tract without difficulty. Perhaps no one thing has so contributed to the suppression of vandalism in the Garden as the construction of this fence.

ATTENDANCE.

The following diagram indicates more graphically than any list of figures, the increasing interest that the people of St. Louis and elsewhere are taking in the Missouri Botanical Garden. While the opportunity to visit the Garden on Sunday afternoon for about eight months of the year is, of course, responsible to some extent for the growing attendance, this is by no means the only factor involved. An analysis of the attendance of former years shows that from twenty to fifty per cent of the years' visitors came on the two open Sundays; consequently, the Sunday attendance for the year 1913 is but little greater, proportionately, than that of previous years. Furthermore, the number of weekday visitors during the year alone equals the average attendance of previous years when the Garden had an average of 30,000 visitors on the two open Sundays. Even before the completion of the new greenhouses, the provision of special floral displays and other attractions, together with increasing publicity, resulted in a decided response from the public; for example, the attendance in January and February of this year—months during which the Garden is not open on Sunday—was three times that of the previous year, a fact due entirely,

I believe, to the attractive display of flowers provided in the north wing of the new conservatory. In March, 1913, there were over 15,000 people at the Garden, while the previous year there were only 1,114. This extraordinary increase is partially due to the fact that on the last two Sundays in March the Garden was open to the public, but the primary

Diagram of Annual Attendance from 1899-1913.



factor involved is, I think, the provision of something that the people wish to see, rather than merely making it possible for them to get into the Garden the additional Sunday afternoons. It is manifestly unfair to compare the attendance for the same months during a series of years, since the weather has a very pronounced effect upon the number of visitors at any specific time. While the long, hot summer of 1913 undoubtedly affected the attendance at the Garden, taking the year as a whole, things average up and the probabilities are that any loss of attendance during the summer was offset by favorable months in the spring and fall. It

should be noted that, owing to the improvements on Shaw Avenue, as well as the construction of the new fence along Tower Grove and Magnolia Avenues, there have been considerable periods during the year when visitors could gain access to the Garden at other points than through the main gate—the only place at which visitors are counted. Particularly on Sundays, hundreds of people came into the Garden at unfenced places and it is quite certain that the total attendance indicated for the year 1913 is less than the actual number of visitors.

ATTENDANCE FOR THE YEAR 1913

	Week-days	Sundays
January	1,457	.....
February	1,683	.....
March	4,532	10,765
April	11,798	20,474
May	14,212	12,968
June	11,081	7,061
July	10,321	7,036
August	11,466	7,147
September	6,387	5,382
October	8,856	5.434
November	24,112	32,211
December	3,276	.....
	109,181	108,478
		109,181
Total		217,659

RESEARCH AND INSTRUCTION

The far-sighted and definite way in which Mr. Shaw provided for the work of research and instruction in botany, both at the Garden and in co-operation with Washington University, is perhaps not any too well known. The following extracts from the will of Mr. Shaw demonstrate his position better than would any elaborate discussion.

> "Having established, maintained and kept open for the use of the public for many years the Missouri Botanical Garden and wishing to perfect my endowment of it, and to augment and perpetuate its usefulness by connecting with it a School of Botany for the promotion of education and investigation in that science, and in its application to Horticulture, Agriculture, Medicine and the Arts," * * *

a certain income is provided,

> "to be used exclusively to pay the salaries, and to defray the necessary incidental expenses of those engaged in botanical instruction and researches at the Garden, and as need may require also within the precincts of the University; also for the

maintenance of the requisite botanical laboratories, and their equipment with instruments and appliances for illustration and investigation, for the maintenance and increase of a botanical library and herbarium; and for such like objects strictly german to a School of Botany."

The will also declares:

*** * * "that scientific investigation in Botany proper, in vegetable physiology, the diseases of plants, the study of the forms of vegetable life, and of animal life injurious to vegetation, experimental investigations in horticulture, arboriculture, etc., are to be promoted no less than instruction to pupils; but I leave details of instruction to those who may have to administer the establishment, and to shape the particular course of things to the conditions of the times."**

The Trustees of the Missouri Botanical Garden are

*** * * "empowered to allot, from time to time, any of the income not needed for the development and maintenance of the said Garden, to the augmentation to the means and appliances of instruction."**

While in the past there has been a most generous attitude shown towards carrying out these provisions of Mr. Shaw's will, as evidenced by the organization and maintenance of those most necessary adjuncts of research and instruction—the library and herbarium—as well as providing opportunities for graduate students, the past year marks a distinct epoch in the further development of the scientific side of the Garden.

At the close of 1912, the activities of this department were centered about physiology and morphology, which form the necessary groundwork for specialization in these as well as in other phases of botany. Aside from the Director of the Garden, these subjects were represented by Dr. B. M. Duggar, in charge of the Graduate Laboratory, Dr. Geo. R. Hill, Research Assistant, and Dr. J. R. Schramm, Assistant to the Director. As a result of the appointment of Drs. J. M. Greenman and E. A. Burt, there has been a notable strengthening of the work along taxonomic and morphological lines, for, aside from their curatorial duties as well as in connection therewith, they are developing the research features of their special fields (seed plants and fungi), at the same time cordially supporting any requisite instructional work.

Graduates and Fellows—Dr. George R. Hill, Jr., resigned his position as Research Assistant in June, and was succeeded by M. C. Merrill, who has been in graduate work at Cornell, Chicago, and Harvard Universities. The following are the 1913-1914 appointments to the Rufus J. Lackland Fellow-

ships: J. S. Cooley, M. S., Virginia Polytechnic Institute (formerly Asst. Pathologist at the Va. Agr. Experiment Station); A. R. Davis, A. B., Pomona College, Calif.; W. H. Emig, A. B., Washington Univ.; Margaret De Meritt, M. S., New Hampshire College (formerly Asst. in Botany N. H. College); and L. O. Overholts, A. B., Miami Univ., Ohio. Miss De Meritt, however, has been temporarily unable to continue her studies on account of ill health.

All graduates who have pursued studies in the laboratories during the calendar year are Ruth Beattie, Mary Bryan, C. O. Chambers, J. S. Cooley, A. R. Davis, Margaret De Meritt, W. H. Emig, G. L. Foster (Teaching Fellow in Washington University), George R. Hill, Jr., M. C. Merrill, Fred Morgan, A. G. Nolte, H. H. Shackelford, J. R. Schramm, Mildred Spargo (Mrs. J. R. Schramm), and R. L. Vaughn. In addition to the above, R. E. Richardson, representing the Illinois State Laboratory of Natural History, has used the facilities of the laboratory while engaged upon a study of biological material collected in the Chicago Sanitary Canal and Upper Illinois River, preparatory to an extensive report on that subject.

Practically all of those taking graduate instruction have been registered for credit and for advanced degrees in the Shaw School of Botany of Washington University. The degree of Ph. D. was conferred by Washington University in June, 1913, upon C. O. Chambers, J. R. Schramm, and Mrs J. R. Schramm, and the A. M. degree was conferred upon A. G. Nolte.

Changes in Staff Members and Graduates—Dr. J. M. Greenman was appointed Curator of the Herbarium on January 1st, and Dr. E. A. Burt became Mycologist and Librarian to the Garden on September 1st. Assistants and graduates who have changed or terminated their connection with the laboratory during the year, are as follows: Ruth Beattie, appointed Assistant in Botany in the University of Missouri; C. O. Chambers, appointed Instructor in Plant Physiology, University of Cincinnati; George R. Hill, Jr. (formerly Research Assistant), appointed Professor of Botany in the Utah Agricultural College; A. G. Nolte, appointed Assistant in the chemical (bacteriological) laboratory of the Water Department, St. Louis; W. W. Ohlweiler (formerly Teaching Fellow in Washington University), appointed General Manager of the Garden; and J. R. Schramm (formerly Assistant to the Director), reappointed and made also Instructor in Botany in Washington University.

Through a satisfactory exchange arrangement, J. S. Cooley continued his researches during the summer in the Department of Plant Pathology, at the University of Wisconsin; and during the first term of 1913-1914 the privileges of the graduate laboratory have been extended to R. L. Vaughn, at present Fellow at the University of Wisconsin.

Publications and Papers—The following papers, by members of the staff or students, have appeared since the publication of the last report:

Moore, Geo. T., "Microorganisms of the Soil." Science, 1913.

Moore, Geo. T. (with Leo Loeb and M. S. Fleisher), "Ueber das Vorkommen von Hefen in menschlichen Tumoren, mit Versuchen ueber das Wachsthum einer pathogenen Hefe im Tierkörper." Centralblatt für Bakteriologie, 1913.

Moore, Geo. T. (with Leo Loeb and M. S. Fleisher), "Ueber das kombinierte Wachsthum tierischen Gewebes und einer Hefe im Blutkoagulum in Vitro." Centralblatt für Bakteriologie, 1913.

Moore, Geo. T., "Taxonomy and Economic Botany." American Year Book, 1912.

Duggar, B. M., "Lycopersicin, the Red Pigment of the Tomato, and the Effects of Conditions upon its Development." Washington University Studies, 1913.

Duggar, B. M., "Physiology and Ecology." American Year Book, 1912.

Greenman, J. M., "A New Senecio from Cuba." Torreya, 1913.

Hill, Geo. R., Jr., "Respiration of Fruits and Growing Plant Tissues in Certain Gases, with Reference to Ventilation and Fruit Storage." Cornell Univ. Agricultural Experiment Station Bulletin, 1913.

Hill, Geo. R., Jr., "Relation of Ventilation to the Keeping Qualities of Fruits and Vegetables." Washington University Studies, 1913.

Thompson, C. H., "Ornamental Cacti, Their Culture and Decorative Value." U. S. Dept. Agr., Bureau Plant Industry Bulletin, 1912.

Spargo, Mildred W., "The Genus Chlamydomonas." Washington University Studies, 1913.

At the meeting of the American Association for the Advancement of Science, Atlanta, Dec., 1913, the following papers were presented by members of the staff, and graduates:

B. M. Duggar, "The Effect of Temperature Upon Certain Tissue or Cell Processes and Some Problems Involved."

B. M. Duggar and J. S. Cooley, "The Effect of Certain Surface Films and Powders on the Rate of Transpiration."

B. M. Duggar and A. R. Davis, "A Preliminary Report on the Isolation and Identification of the Enzymes of *Fucus vesiculosus*."

G. L. Foster, "Indications Respecting the Source of Combined Nitrogen Used by *Ulva lactuca*."

Jacob R. Schramm, "The Relation of Certain Grass-Green Algae to Elementary Nitrogen."

The papers last noted will appear in the first two numbers of the new scientific quarterly journal of the Garden, together with others dealing with the following topics: A. G. Nolte, Regarding a new method for the bacteriological examination of air; L. O. Overholts, Native Polypores of Ohio; J. R. Schramm, The relation of certain species of grass-green algae to elementary nitrogen, and Pure culture methods in the algae; E. A. Burt, A general statement preliminary to a monograph of the Thelephoraceae; J. M. Greenman, Notes preliminary to a monograph of the genus Senecio.

Laboratory Facilities—Marked progress has been made in adjusting the arrangements of the laboratory to the new demands, and in strengthening the facilities for research, at the same time segregating the different aspects of the work with a view to higher efficiency. The first floor of the laboratory wing of the main building is used, as in previous years, for a lecture room and office. The second floor is now occupied by (1) a large conference room serving as headquarters for the study and microscopic work of graduate students, also as seminar room; (2) a small balance room; and (3) a staff research laboratory for physiology and bacteriology. The third floor is given up to one large experimental laboratory, which is being equipped, as rapidly as possible, with all the facilities for the most exacting experimental studies. During the year there have been added chemical tables, lockers, and cases, an additional transfer room, a four-compartment incubator, new precision apparatus, a large water still, and much additional glassware and chemicals, affording excellent opportunities for research work, especially along physiological lines.

Instruction, Lectures, Etc.—Courses offered in the Shaw School of Botany by the members of the staff of research and instruction during 1912-1913 were twelve in number, including General Botany, Bacteriology, Morphology and Taxonomy of the Fungi, Morphology and Taxonomy of the Algae, Morphology and Taxonomy of the Spermatophytes, Advanced Physiology, Sanitary Bacteriology, Taxonomy, Seminar, and Research in several phases of botany.

During the year the following lectures were delivered in St. Louis and vicinity:

Geo. T. Moore, May 19th, before the St. Louis Academy of Science, "Speculations on the Origin of Life."

Geo. T. Moore, Oct. 21st, before the Science Section of the Wednesday Club of St. Louis, "Conservation of the Soil."

Geo. T. Moore, Dec. 2d, before the Garden Club of Webster Groves, "The Organization and Work of the Garden Club."

Geo. T. Moore, Dec. 3d, before the Alumni Assoc. of the St. Louis College of Pharmacy, "The Missouri Botanical Garden and Its Relation to the Public."

B. M. Duggar, March 20th, before the St. Louis Biological Club, "The Production of Enzymes in Certain Filamentous Fungi."

B. M. Duggar, April 21st, before the Academy of Science, "The Significance of Color in Plants."

B. M. Duggar, May 21st, before the Scientific Association of the University of Missouri, "The Physiological Significance and Heredity of Color in Plants."

H. von Schrenk addressed the October meeting of the St. Louis Chapter of the Am. Institute of Architects on "Modern Uses of Timber."

J. M. Greenman, April 15th, before the Tuesday Club, "Trees."

J. M. Greenman, Dec. 1st, before the Academy of Science, "The Flora of the Gulf Coastal Plain."

C. H. Thompson, before the Neighborhood House and Boyle Memorial Center, "The Construction, Preparation and Planting of a Window Box."

An unusual number of inquiries from the people of St. Louis and vicinity, relative to all aspects of botany and horticulture, have been answered by members of the staff. The wider publicity which has been given to the increasing

activities of the Garden along all the lines for which it was designed by Mr. Shaw, has resulted in the public turning to the Garden for information and advice upon many subjects. For those concerned with research and instruction, this phase of the work is demanding more and more time.

THE HERBARIUM

Marked progress has been made during the year in the herbarium. Its congested condition made it necessary to provide additional space, consequently a complete rearrangement of the cases on the third floor was made. Several new wood cases of an inexpensive type for temporary use were installed, thus giving increased capacity sufficient to incorporate the large accumulation of undistributed mounted specimens and to accommodate a normal growth of the collection for the ensuing year. The rearrangement of cases necessitated a complete shift of more than one-half of the entire collection, but it economizes floor space, gives a better working light and increases materially the convenience and efficiency of the herbarium. Considerable time has been devoted to the determination of several thousand mounted and unmounted plants which have been in storage for some years in the Museum building. Among these collections were Henry's plants of China, Bang's, and Rusby's plants of South America, Palmer's plants of Mexico, Orcutt's plants of Mexico, Gaumer's plants of Yucatan, and numerous smaller collections from various localities. The major part of these are now named and incorporated with the organized part of the herbarium.

The poisoning and mounting of herbarium specimens has continued uninterruptedly throughout the year, except during the month of September and the first two weeks in October.

During the year the herbarium has been consulted by twenty or more prominent visiting systematists and numerous loans of material in particular plant groups have been made to American and European specialists for the purpose of monographic study.

New Accessions—The amount of herbarium material acquired during the year is relatively large. Two collections of special importance may be mentioned: first, the private herbarium of the late Mr. George W. Letterman, which is estimated to contain upwards of 15,000 specimens. This collection, secured by purchase, is of particular value to this institution because it consists mainly of a very complete

suite of Missouri plants, and the specimens are accompanied by full and careful notes. Moreover, it represents the work of Mr. Letterman covering a period of nearly forty years, during which time he not only made extensive collections in Missouri, but also collected personally in Arkansas, Colorado, Idaho, Kansas, New Jersey, Oklahoma, Pennsylvania, Texas and Wyoming. Mr. Letterman carried on a large correspondence and freely exchanged plants with contemporaries, so that his herbarium includes some series of *exsiccatae* from noted collectors, such as Curtis, Hasse, Macoun, Palmer, Parish, Rusby, Sandberg, Small, Swan and Vasey. Much of this material will be of value for exchange purposes. A second valuable collection for the Garden is the private herbarium of Dr. J. M. Greenman, which was acquired by gift. The collection contains upwards of 10,000 specimens from New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Ohio, Michigan, Indiana, Illinois and Wisconsin. The plants were collected during the years 1890 to 1902 and in many cases are duplicated in the Gray Herbarium by specimens which have been cited in botanical literature, particularly in *Rhodora,* in the course of recent intensive studies of the New England flora.

Other important accessions have been obtained by gift, exchange and purchase. Among the more noteworthy are the following: Bartholomew's "Fungi Columbiani" and "North American Uredinales," Broadway's plants of Tobago (W. I.), Buchtien's plants of Bolivia, Bush's plants of Missouri, Carr's "Phanerogams of Northwestern South Dakota," Chandler's plants of Texas, Clokey's plants of Illinois, Saskatchewan and Mexico; Greenman's plants of Arizona, Haynes' "North American Hepaticeae," Holzinger's "N. A. Mosses," Krieger's "Fungi Saxonici," Macoun's plants of Canada, Nelson's plants of Idaho, Utah, Colorado and Nevada, Nieuwland's plants of Indiana, Orcutt's plants of Texas and Mexico, Pennell's Scrophulariaceae of the Atlantic and gulf coastal-plane, Purpus' plants of Mexico, Tilden's plants of the South Pacific Islands, Visher's plants of South Dakota, von Schrenk's plants of the United States, Zenker's plants of Kamerun, and numerous smaller accessions recorded in the Missouri Botanical Garden Bulletin.

Organization of Old Material and Exchanges—The organization, namely labeling and laying out in duplicate sets, of the miscellaneous unmounted specimens secured on accessions in former years, has progressed as rapidly as the time and assistance would permit. The private herbarium of the

late Mr. Henry Eggert has been fully organized and more than 10,000 duplicates from this collection have been distributed to the Garden's correspondents on the basis of exchange.

Stamping and Numbering—A system of stamping and consecutive numbering has been introduced; and all specimens after being mounted are stamped, by means of a combined stamp and automatic numbering machine, with a distinctive Garden imprint, and at the same time consecutively numbered so that an exact record is obtained of the number of specimens mounted each day, thereby forming an accurate basis for monthly reports. Plants already in the organized herbarium are also being similarly stamped, and up to the present time 41,011 sheets of this series have been stamped. Thus, eventually a complete inventory, as to number of specimens in the collection, will be recorded and available at all times. The stamped and numbered sheet greatly facilitates the matter of records, particularly in connection with the loan of herbarium specimens.

Field Work—Pursuant to the plan for a botanical survey of the Southwest and for publishing eventually a flora of this region, Mr. Ernest J. Palmer has spent the autumn months collecting in the vicinity of Noel, Golden City, Galena, Branson, Williamsville and at other places in southwestern Missouri, as well as at Eureka Springs, Cotter and Moark in northwestern Arkansas. Although the collecting season this fall was unusually short, Mr. Palmer has made substantial and satisfactory progress, having secured several thousand excellent herbarium specimens, including a sufficient number of duplicates to enable the Garden to place a few sets of plants illustrating the flora of the Southwest in remote botanical centers where they will be accessible for reference.

Statistical Summary: (For the year ending December 31, 1913.)

Number of specimens acquired:

By purchase	22,833
" gift	12,899
" exchange	5,162
" field work	2,695
" miscellaneous sources	171
Total	43,760

Number of specimens mounted and incorporated	21,840
" " duplicates sent out in exchange	11,014
" " specimens discarded from herbarium	659

Total number of specimens in organized herbarium 635,841, valued at	$ 95,376 15
Value of unorganized material	22,042 50
Wood specimens, etc., valued at	280 00
Microscope slides, valued at	410 00
	$118,108 65

LIBRARY

There have been 603 volumes, valued at $1,290.20, and 1,178 pamphlets, valued at $212.75, donated to the library; and 320 volumes, valued at $1,358.60, and 46 pamphlets, valued at $31.10, were purchased. There were also donated two manuscripts, valued at $2.00, and six maps, valued at $100.25. A total of 18,123 index cards have been added, 7,800 of which were written by Garden employees, and 10,323 purchased at a cost of $141.67. The number of books bound was 578; rebound, 13.

Early in the year an inventory was made which increased the number of volumes and decreased the number of pamphlets previously reported, so that at the end of 1912 the figures should have been:

Books	30,961
Charts and maps	140
Pamphlets	40,389
Manuscripts	115

With the additions for 1913, the library now contains:

Books			31,884
Pamphlets			41,613
Total	73,497,	valued at	$111,496 67
Manuscripts	117,	" "	1,594 00
Maps and charts	146,	" "	153 25
		Total	$113,243 92
Index cards	805,692,	valued at	8,095 36
			$121,339 28

There are now received at the library, 1,519 serial publications from 1,138 institutions and publishers; 115 are purchased and 1,404 are in exchange for Garden publications.

It has become evident that some of the institutions and societies, whose publications we receive by exchange, are not interested in botany and issue nothing of use to a botanical library, although of great value in other fields of science. A thorough examination of our series of such publications has been made with the result that about 80 publications should be discontinued or transferred to other libraries. Additional botanical exchanges will be sought to take their place.

The value of the library is being steadily increased by taking advantage of all opportunities to add to and complete our sets of botanical publications and to secure current botanical literature as rapidly as issued.

ANNUAL BEQUESTS

The flower sermon, provided for in Mr. Shaw's will, was preached in Christ Church Cathedral by the Rev. Francis L. Palmer, of Stillwater, Minn., on May 18, 1913, and the Twenty-fourth Gardeners' Banquet was held on the evening of December 17, 1913, at the University Club. Mr. John Noyes, of Boston, gave an illustrated talk on the Boston park system.

In addition, mention should be made of the prizes offered by the Missouri Botanical Garden at the International Flower Show, held in New York City, April 5th to 12th, at which a prize of $200 was awarded to Adolph Lewisohn, Ardsley, N. Y. (Mr. J. Canning, Gardener), for a new variety of jewel flower (Impatiens); and a prize of $100 was awarded to John Wannamaker (Mr. John Dodds), Supt., for a variegated pandanus. No award of the $200 prize offered for a new economic plant was made, as none of the specimens submitted were considered as being up to the high standard set.

GARDEN PUPILS

Mr. Carl Haltenhoff and Mr. Earl Reed have, during the year, completed the course prescribed for Garden pupils and received the certificate given by the Garden. The following at present hold Garden scholarships: Peter Pfaender, Fred Grossart, Carl Giebel, Nestor L. Philippi, and Andrew J. Cella. Part of the time of Mr. Ohlweiler, Mr. Thompson

and Dr. Schramm has been devoted to the instruction of these pupils and the usual amount of time has been given to work in the Garden and greenhouses.

Respectfully submitted,

GEORGE T. MOORE,
Director.

STATISTICAL INFORMATION FOR DECEMBER, 1913.

GARDEN ATTENDANCE:

Total number of visitors	3,276

PLANT ACCESSIONS:

Total number of plants received in exchange	14
Total number of packets of seeds received in exchange	22

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	22
Total number of books and pamphlets donated	155

HERBARIUM ACCESSIONS:

By Purchase —

E. Bartholomew — "Fungi Columbiani," Cent. XLI, XLII, Nos. 4001-4200	200
W. E. Broadway—Plants of Tobago, W. I.	50
F. S. Collins — "Phycotheca Boreali-Americana," Fasc. XXXIX	50
P. B. Kennedy—Plants of Nevada	200
Th. Oswald Weigel — Heribaud's "Collection der Phanerogams de l'Amerique du Sud," Cent. I	100
Th. Oswald Weigel — Zenker's "Plantae Kamerunenses," Cent. IV	100

By Gift—

B. F. Bush—Plants of Minnesota	8
H. P. Chandler—Plants of Texas	35
W. H. Emig—Plants of the Ozark Region, Missouri and Arkansas	184
E. M. Whelpley—Plants of Montana	59

By Exchange—

C. R. Ball—North American Willows	18
Hungarian National Museum—"Flora Hungarica exsiccata," Cent. I	100
Leland Stanford Jr. University—Plants of California	62
J. A. Nieuwland—Plants of Indiana, Michigan and District of Columbia	582
C. S. Sargent—Pines of Mexico and China	55
University of Vienna—Plants of Austria-Hungary	400

By Field Work—

Ernest J. Palmer—Plants of Missouri and Arkansas	1,971
TOTAL	4,174

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free. During the winter, beginning with the first Sunday in December, the Garden will be closed on Sundays.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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HENRY MEIER,
In Charge of Main Garden.

MAX SCHILLER,
In Charge of New Plant Range.

Missouri Botanical Garden Bulletin

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Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., February, 1914 No. 2

In Memoriam

Dr. John Green

Dr. John Green, a member of the Board of Trustees of the Missouri Botanical Garden for nearly twenty years, died on December 7, 1913. The following resolution was adopted by the Board at the meeting of January 14, 1914, ordered spread upon the minutes, and an engrossed copy sent to the family:

> **"The death of Dr. John Green leaves a vacancy in the ranks of the votaries of science, and indeed in the civic activities of all of St. Louis. This city had been his home since 1866, and he had helped in no inconsiderable degree to make it illustrious by his contributions to the enlarging field of ophthalmological science, and by beneficent inventions in the line of relief to suffering humanity.**
>
> **"The Board of Trustees of the Missouri Botanical Garden, of which body Dr. Green had been a member since 1895, asks to associate itself with the citizens of St. Louis in deploring the loss sustained by his death; and, furthermore, it asks to be allowed to bear witness to the steadfast and faithful devotion that he has ever been ready to give to the directing of the counsels and the promoting of the interests of the Board.**
>
> **"The Board, in consciousness of its great loss, begs to put on record its deep appreciation and warm gratitude for his unfailing helpfulness, and to extend to the widow and family the assurance of its affectionate sympathy."**

A DEMONSTRATION OF SOME IMPORTANT RELATIONS OF PLANTS TO LIME AND OTHER SOIL NUTRIENTS

During the present month, and continuing into March, there are on exhibit in the south wing of the new greenhouses some demonstrations illustrating in a convincing manner some of the most important relations of plants to the mineral fertilizers and other growth factors of the soil. In general, these experiments are designed to show, among other facts, what elements of the soil are essential in plant growth; the relation of growth to a variety of soil factors, especially the deleterious action of the essential salts when these are used singly rather than in a properly balanced ratio; and the importance of a neutral or alkaline condition (attained by liming) for the best growth of certain plants, as contrasted with acidity, which is requisite for others.

The Nature of Plant Substance.—The bulk of any green herbaceous plant is water, 60-90 per cent ordinarily, and in the case of cress or cucumber this may amount to more than 90 per cent of the total weight. Organic or combustible substance, as we may roughly designate it, constitutes commonly from 10-20 per cent of succulent plants; while the mineral or salt content of fresh plant tissues is usually less than 2 per cent. But the mineral "plant foods," or nutrients, are as necessary as the organic matter and the water. However, the green plant makes its organic food through the use of the carbon dioxide of the air as raw material, while the mineral constituents are, like the water, derived from the soil. To this fact is due in part the importance of a proper soil in the production of plants. Soils are most diverse, and not merely so with respect to color and origin. More important are the differences in texture and water content; the form, availability, and relative concentration of the mineral constituents; the presence of organic matter; the occurrence of compounds injurious to plant growth; and the activity of micro-organisms. In any case the soil solution, that is, the water of the soil, must, of course, contain any soluble substance present in the soil. Moreover, such constituents enter the plant only in solution. If we grow plants to demonstrate or determine their mineral requirements, it is well to employ water cultures to which we may add just those substances the effects of which we wish to observe. Water cultures have been most valuable in shedding light on various problems relating to plant life, and they are most convenient for our purpose here.

Methods.—The methods involved are simple. Tumblers or glass cylinders are used as containers for the culture solu-

tion, and the tops of these vessels are covered with paraffined paper. The latter supports the seed, and through punctures in the paper the growing roots are brought into the solution. Under suitable conditions the stems and leaves then grow normally, and the roots may almost fill the vessels. But before describing some of the points which the experiments themselves are designed to show in detail, it is perhaps well to define briefly some relations of plants to the mineral constituents.

The Necessary Minerals.—In order to afford more or less perfect growth or development, the water cultures, such as those above mentioned, should contain in the form of soluble salts the elements nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, and iron. The concentration of the total salts should be less than 1 part of the salts in 1,000 parts of water. The experiments displayed are arranged in eleven groups. In some of the groups three kinds of plants are employed, while in others only one is used; in each case, then, one or more of the following: Canada field peas *(Pisum arvense)*, horse beans *(Vicia Faba)*, and corn *(Zea Mays)*. The various groups and some general notes on the chief facts which they point out are enumerated below.

Group I. The plants are grown in a full nutrient solution—with all necessary mineral constituents present—: here normal growth occurs. The actual constitution of this solution is as follows:

Calcium nitrate	**4.0 grams**
Potassium nitrate	**1.0 gram**
Magnesium sulphate	**1.0 "**
Potassium phosphate	**1.0 "**
Potassium chloride	**0.5 "**
Iron chloride	**trace**
Water	**40 liters**

Contrasted with this are cultures in which the calcium salt (lime) alone is omitted, from which it is clear that a solution lacking this one constituent is in no way suitable for growth. Another culture lacking only the very important element nitrogen (as nitrates or compounds of ammonia) exhibits a checking of growth which is less marked, due in part, of course, to the fact that the seed leaves (cotyledons) furnish organic nitrogen in sufficient quantity for the early growth stages; but when the seed leaves are cut off a more marked diminution in growth occurs. Plants may be grown to maturity in solution cultures, if fresh solution is added occasionally.

Group II. A salt of magnesium used alone is injurious at a lower concentration than any other mineral nutrient. About three-hundredths of one per cent of magnesium chloride practically prevents growth. The addition of a small amount of a calcium salt, however, entirely overcomes the injurious or toxic action of the magnesium; hence the calcium exhibits towards magnesium a strong antitoxic or antidotal action. It may seem remarkable that a single nutrient salt used in this way should not be able to induce an amount of growth equal at least to that occurring in distilled water, and more remarkable that it may entirely inhibit growth. Nevertheless, it is a general rule (calcium salts being an exception in certain cases) that plants and animals alike suffer injury in very weak solutions of the necessary mineral nutrients used singly.

Group III. A sodium salt (for example, common table salt) used alone, is less injurious than the same concentration of magnesium, but it is nevertheless distinctly injurious at five-hundredths of one per cent. In this case also, calcium is a strong antitoxic agent, so that in the presence of calcium it is possible for plants to grow at much higher concentrations of sodium.

Group IV. The remarkable property shown by calcium of antagonizing other mineral bases is exhibited to a lesser degree by most of the other bases as well, thus potassium and magnesium are to a certain extent mutually antagonistic, so that a mixture of the two is never as toxic as either alone. The corrective effect of the one substance on the other is obvious, even though the growth in the mixed solution may not be equal to that in distilled water.

Group V. Barium, although related to calcium, is in reality a very injurious mineral with respect to plant growth, but in this case, also, the plant will endure much stronger solutions of the poison in the presence of calcium.

Group VI. The metal manganese is about as injurious as barium, but its action is especially interesting on account of the fact that even at great dilution it induces a yellowing, or *chlorosis,* of the leaves. Again, at a somewhat higher concentration it inhibits effectively the growth of shoots, although permitting normal root development. Calcium is here, as in the case of magnesium, sodium, and barium, the strongest antidote known.

Group VII. In a proper full nutrient solution there is a very complex and happily balanced state of affairs, each substance tending to check any possible injurious action of cer-

tain others, while each is necessary in its specific way. In such a mixed solution, moreover, a deleterious agent like manganese exerts a toxic action only when it is present in much greater concentration than when associated with only one of the salts constituting the mixed solution.

Group VIII. In a soil culture, the relation of plant growth to the various factors of the environment is even more complex than in a full nutrient solution culture, and in general a toxic agent is less injurious in a soil culture than in the usual solution culture. Manganese salts, for example, are injurious only when solutions are used twice as concentrated as in the previous group. Still, manganese is sometimes present in field soils to an injurious extent. The degree of its toxicity in a soil will depend upon a variety of factors of which the following are important: fineness of particles (more injurious in coarse sand than in fine), the relative abundance of antagonistic substances, the amount of organic matter present, and the acidity or alkalinity. There are probably very few soils which do not contain injurious substances of some kind, but under such complicated conditions their effects are nearly always minimized.

Group IX. A poor soil will, of course, encourage less rapid growth than a "fertile" one. Without attempting an analysis of all the conditions that constitute "fertility" or "infertility" of a soil, it may be said that plants show diverse capacities to tolerate acidity, and acidity of field soils is not infrequently a cause of apparent "infertility." Lime (either as limestone or as air-slaked lime) is the most satisfactory corrective of this condition. It neutralizes the acid, and is said to "sweeten" the soil. In smoke-besieged cities, excessive acidity of lawn soils is common on account of the precipitation of a certain amount of sulphurous acid. Liming is therefore often required in the maintenance of satisfactory lawns. There are, however, soils which are naturally acid. The bog and certain woodland soils of the eastern states are notably acid, and under such conditions, the blueberry and other heaths, for example, grow luxuriantly. Recent work has also shown that the blueberry thrives in cultivation only when this requirement is observed.

Group X. It might be supposed that under no conditions would our ordinary soil plants grow properly, even for a short time, if completely submersed. It is possible, however, to grow peas, wheat, and many other plants entirely submersed for a few weeks, provided only that the water is streamed through the vessels. This streaming of the water

insures adequate aëration, and, at the same time, serves to carry off any products which may diffuse into the water from the germinating seeds.

Group XI. The ability of all leguminous plants (clovers, beans, etc.) to utilize atmospheric nitrogen is well known. This is accomplished through the intermediary of bacteria in certain nodules, or tubercular swellings, made by the bacteria on the roots of these plants. One of the greatest problems in agriculture is to secure and maintain an adequate supply of combined nitrogen in the soil, and often the best means of accomplishing this is through the nitrogen-fixing power of legumes. The conditions favorable for the fixation of nitrogen are most important. It is interesting that in the presence of rather large quantities of nitrogen in the solution culture, nodules do not readily form; but when nitrogen is deficient, a profuse development of nodules occurs. Moreover, in solution cultures in which no combined nitrogen is supplied, the plants secure an adequate supply merely through the action of the bacteria mentioned.

Plate 1 is made from a photograph of the experiment with peas in group II, supplemented by three cultures from group I, and these are illustrative of the comparisons to be noted in other groups. The photograph was taken ten days after the cultures were made, and as growth continues the comparisons will become more marked. The following is an enumeration of the cultures, the numbers corresponding to those appearing in the plate:

1. Calcium salt alone ($\frac{1}{100}$ standard concentration), which permits good growth for a certain time interval—about three weeks.

2. Magnesium salt alone ($\frac{1}{100}$ standard concentration), which permits no growth.

3. Magnesium salt alone ($\frac{1}{500}$ standard concentration), which permits little growth.

4. Combines calcium and magnesium salts as used in Nos. 1 and 2, and here the calcium prevents injury from the magnesium.

5. Combines the calcium and magnesium as in No. 4, but the latter is increased in strength four times; still the calcium prevents any considerable injury.

6. Combines calcium and magnesium as in No. 4, except that there is only one-tenth as much calcium; but its beneficial effect is still obvious.

WATER CULTURES OF PEAS SHOWING SOME OF THE IMPORTANT RELATIONS OF MINERAL NUTRIENTS TO PLANT GROWTH.

7. Distilled water (no salts or other nutrients present), which will permit growth to continue slowly for a few weeks.

8. Full nutrient solution (weak) containing all necessary mineral constituents, which will permit continuous growth.

9. Full nutrient solution lacking calcium, showing slight growth, and emphasizing the special need of this as a nutrient and antagonistic agent for the best growth of peas.

10. Full nutrient solution lacking nitrogen; considerable nitrogen, however, being still supplied through the cotyledons.

FLORAL DISPLAY

On account of contemplated improvements in the north wing of the new conservatories the flowering plants were removed to the south wing, which, with the additional flowering material and foliage plants, presents a most attractive appearance. Although the bright colored Christmas flowers have largely passed, and it is yet too early for the typical Easter plants, a pleasing floral display has been arranged to follow the poinsettias, primulas, azaleas, solanums, cyclamen, begonias, etc., of the January exhibit. Some of the January plants are still showy and have been distributed in other houses of the new range, notably in the economic house, where at the present time several hundred plants of begonia "Erfordii," with their clear pink flowers, are providing a pleasing bit of color.

In the first wing of the display house a dozen standard genistas *(Genista canariensis)* are the most striking plants. The flowers of bright yellow show up strikingly against the silvery green background of their leaves. Such standard forms are produced only after much patient effort on the part of the grower, and require considerable time and skill for their production. At the International Flower Show in New York last year, standard genistas were among the most attractive specimens shown. The plant belongs to the pea family, and the close observer will note the similarity in their flowers to those of peas, beans, etc. The dozen plants in the Garden collection are arranged on either side of the central walk, and the spaces between them and extending back to the foliage plants are filled with bright colored cinerarias. These plants, with their large green leaves and immense heads of showy flowers, are always a source of interest and pleasure. In color the flowers show an almost endless variation from the more delicate shades to the most intense colors imagin-

able. The plants will continue to be attractive for several weeks. White and lavender stocks, the latter in several shades, are arranged in the green background of foliage plants.

At the entrance to the second section of the house is a mass of spiraeas with white or pinkish fleece-like flowers, accentuated by the panicles of the rose colored plumbago immediately behind it. Just in front is a small group of plants that are perhaps new to Garden visitors. These are specimens of Nemesia, a native of South Africa, and although introduced some twenty years ago, it has become prominent as a garden plant only in recent years. While the flowers—similar, in general, to the foxglove and snapdragon—are small, being only one-half to one inch across, they are remarkable in matured plants for their profusion and beauty of color, the latter ranging through yellow, rose pink, rich orange, white, crimson and scarlet. The plant has a long flowering season and, like *Plumbago capensis,* is a South African cape species. On account of the success last summer of the cape leadwort *(Plumbago capensis)* as an outdoor plant in the Garden, the nemesias will be tried in a similar capacity during the coming summer. The plants shown in the greenhouses are of mixed shades, but those used outside will be in pure colors. The azaleas, which formed the center group of the second house early in the month, have been replaced by a bank of cinerarias, smaller groups of which are to be found also in the far west corners of the house.

The bench of lily-of-the-valley, mixed with begonia "Gloire de Lorraine," which made so attractive a combination early in the month, is now occupied by a collection of beautiful blue-flowered cinerarias. Parts of the central group are occupied by begonias and rambler roses. The southern bench is filled with plants of the Chinese primrose *(Primula sinensis)*. A number of good cyclamens were exhibited, but not in such large quantities as last year, because the past hot and dry summer was particularly trying on these plants. A few plants of *Begonia peltata* have been much admired. Calla lilies have been conspicuous during the month, and will continue to come out from time to time.

During the coming month the show of cinerarias, stocks, spiraeas, etc., will be supplemented by large numbers of antirrhinums, lobelias and mimulus.

ORCHID DISPLAY

The nun orchid *(Phaius grandifolius)*, mentioned in the December BULLETIN, is well represented among the flowering orchids. The four plants exhibited are bearing eleven spikes, with an aggregate of two hundred brownish white flowers. The plants are terrestrial in their habit, and are indigenous to the moist regions of Asia and Australia. Under greenhouse culture they require a treatment entirely different from that of the epiphytes, e. g., the cattleyas. Instead of being grown in peat and moss, they are grown more like the palms, in rich, loamy soil, and treated with organic fertilizers before their flowering period. The plants grow continuously, no resting period being required as in the majority of orchids. *Spathoglottis aurea Vieillardi,* bearing a solitary spike of light yellow flowers, is also terrestrial in its habit. It requires only a partial rest after flowering. The variety at present in bloom is of garden origin, being a cross between *S. aurea* and *S. Vieillardi.*

The cattley orchid *(Cattleya Trianaei)*, with its large mauve flowers, is still represented by several good specimens. Luddemann's orchid *(Cattleya Luddemanniana)*, closely resembling the cattley orchid, is also in flower. The braided orchid *(Lockhartia pallida)*, a native of the Panama region, has several spikes of delicate, white flowers. Its most interesting feature is the braided appearance of the long, thin, flat leaves.

Oncidium is a genus variable in the foliage of its species. The baby's bonnet orchid *(Oncidium luridum)*, with long pendant spikes of brownish flowers, has large leathery leaves, whereas the fan orchid *(Oncidium iridifolium)*, with light yellow flowers, has its leaves equitant, resembling a small fan in their arrangement. *Oncidium Cebolleta* and *Oncidium stipitatum* are entirely different in their foliage. Instead of having large, leathery, or small, fan-shaped leaves, they bear long needle-like leaves. The flowers are small and yellowish, somewhat resembling those of the fan orchid. *Oncidium splendidum* has large yellow-lipped flowers on tall upright spikes. The leaves, which are attached to prominent pseudobulbs, are very rigid and of a brownish color.

The Schomburgk's orchid *(Schomburgkia undulata)*, a native of Venezuela, is producing two large spikes bearing clusters of dark purple flowers. The sepals and petals are undulate, giving a crested appearance. The collection of slipper orchids is represented by upwards of twenty varieties

with flowers of various colors. The hybrids "President McKinley" and "Tonso-Charlesworthii" have particularly large, well-shaped flowers. *Cypripedium hirsutissimum,* a native of the Burmese region, is interesting because of its hairy flowers with purple petals.

In an adjoining house, the collection of rainbow flowers *(Ixora Fraseri),* natives of India, with their large, crimson blossoms, give a pleasing effect among the various foliage plants.

NOTES

Miss Herta Toeppen, a graduate of the Garden course, now of Buffalo, New York, visited the Garden, December 31.

On January 5, Dr. L. D. Haigh of the Department of Agricultural Chemistry of Missouri University, visited the Garden.

The exhibition collection of succulent plants has been considerably augmented by new varieties formerly growing in the propagating houses.

Dr. M. J. Dorsey, Professor of Horticulture in the University of Minnesota, is spending a month at work in the Graduate Laboratory, and in the Library.

Mr. W. W. Ohlweiler, General Manager of the Garden, addressed the Garden Club of Webster Groves, Missouri, on January 12. The subject of Mr. Ohlweiler's address was "Garden Plans."

Prof. J. C. Arthur and Mr. Fromme, both of Purdue University, visited the Garden on February 6, en route for the Southwest, where they will spend some time in the collection of rust fungi.

A special course in the general morphology of higher plants, including the chief functions of the various plant-organs, is being conducted at the Garden by Dr. J. M. Greenman, Curator of the Herbarium.

Twenty salesmen, of the Forbes Bros. Tea and Spice Co., under the leadership of Mr. George Lang, Jr., were conducted through the Garden, December 30. The visitors were especially interested in the economic section of the new conservatory.

Mr. E. C. Ewing, Agronomist to the Mississippi Agricultural Experiment Station, is spending half a semester in the Graduate Laboratory, working over some extensive observa-

tions which he has made relative to the ecology of the cotton plant.

Dr. Hermann von Schrenk, Pathologist to the Garden, addressed the Bell Telephone Club, at the Mercantile Club, on December 17. The subject of Dr. von Schrenk's address was "Decay and Preservation of Poles, and Maintenance of Telephone Lines."

The following addresses were delivered by Dr. George T. Moore, Director of the Garden: On February 17, before the Washington University Association, "Speculations Regarding the Origin of Life"; on February 20, before Town and Gown, "Botany and the Town."

At the Atlanta meeting of the American Association for the Advancement of Science, Dr. B. M. Duggar, Physiologist to the Garden, was elected Vice-president of the Botanical Society of America. At the same meeting, Dr. Duggar was made a member of the Editorial Board of "Phytopathology."

The newly created position of Horticulturist at the Garden has been filled by Mr. John Noyes. Mr. Noyes was graduated from the Massachusetts Agricultural College in 1909, and served the same institution as Instructor in Landscape Gardening from 1909-11. Since that time and until coming to the Garden, Mr. Noyes has been in the employ of Warren H. Manning, Landscape Designer, of Boston, Massachusetts.

Mr. Julius Erdman has been employed as gardener. Mr. Erdman studied at the Hoehere Gartenbau Lehranstalt, in Koestritz, Germany, graduating from the latter institution in 1897. Before coming to the Garden, Mr. Erdman held the position of Florist and Gardener at the Colorado State Agricultural College and Experiment Station, giving instructional work in floriculture, landscape gardening, plant propagation, and kindred subjects.

Dr. Hermann von Schrenk, Pathologist to the Garden, has been appointed Consulting Engineer of the National Lumber Manufacturers' Association, an affiliation of all lumber manufacturers' associations of the United States. A prominent feature of Dr. von Schrenk's work in this capacity will be the direction of a scientific investigation of the various important problems touching the use of lumber, such as decay-producing factors, adaptability to various uses, preservation, fireproofing, etc.

STATISTICAL INFORMATION FOR JANUARY, 1914.

GARDEN ATTENDANCE:

Total number of visitors	2,124

PLANT ACCESSIONS:

Total number of plants received in exchange	524
Total number of packets of seeds received in exchange	73
Bulbs received by gift	19,659

PLANT DISTRIBUTION:

Total number of plants distributed	77

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	90
Total number of books and pamphlets donated	298

HERBARIUM ACCESSIONS:

By Purchase —

H. Sudre—plants of Europe:	
"Herbarium Hieraciorum" Fasc. III	50
"Batotheca Europaea" Fasc. XI	50

By Gift —

B. Mackensen—plants of Texas	2
Parke, Davis & Co. — *Macrozamia Moorei*, F. Muell. from Queensland, Australia	1
E. J. Palmer—plants of Missouri	16
R. E. Vaughan—plants of Missouri and Wisconsin	17

By Exchange —

Gray Herbarium, Harvard University, senecios from Washington	4
New York Botanical Garden—plants of the West Indies	249
TOTAL	389

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free. During the winter, beginning with the first Sunday in December, the Garden will be closed on Sundays.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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Assistant to the Director,

JACOB R. SCHRAMM.

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In Charge of Main Garden and Outdoor Collections.

GEORGE PRING,
In Charge of Orchids and Exotics.

HENRY MEIER,
In Charge of Construction Work.

MAX SCHILLER,
In Charge of New Plant Range.

MISSOURI BOTANICAL GARDEN BULLETIN

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ST. LOUIS, MO.
1914

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ROSE GROWING IN ST. LOUIS

The growing of roses in this locality does not require the extreme amount of skill that has generally been supposed. On the contrary, successful rose growing is possible, provided a few general conditions of culture are understood and carefully observed. The idea has become general that owing to the extreme weather conditions prevalent during the summer months in St. Louis, roses will bloom only during early summer and early fall. The experience with roses in the Garden last summer, however, demonstrated beyond all question that with reasonable care any unfavorable climatic influences in St. Louis can be successfully overcome.

Although the weather was particularly trying, as regards temperature and moisture, the roses in the rose garden presented an almost uninterrupted blooming period from early spring until late fall. The prime requisite for rose growing in this locality is an abundance of water; when all other conditions are reasonably favorable, there should be no difficulty in getting roses to bloom continuously. While the following account has been prepared with the roses in the Garden particularly in mind, it should apply equally well to any rose garden in St. Louis or the immediate vicinity.

THE ROSE GARDEN IN THE MISSOURI BOTANICAL GARDEN

The rose garden is located to the west of the administration and laboratory building and directly south of the old Shaw mansion. The central feature of the garden is a large pergola upon a raised embankment, the latter covered with four varieties of trailing roses. The pergola itself is gradually being overgrown with a number of climbing roses of the best sorts. The garden in general is conventional in design, being composed of numerous beds separated by straight and curved walks (see plan in the May, 1913, BULLETIN). The main body of the beds lies to the north of the pergola and of the walk running through

the latter and connecting the administration building with the medicinal garden. The path is marked on either side by occasional sentinel-like standard roses connected by hedges of other varieties. The east and south sides of the garden are shortly to be bordered by a hedge of "Clothilde Soupert" roses, dotted at intervals with iron posts upon which many varieties of climbing roses will be grown. The entrances to the garden through this proposed hedge will be marked by arches, harmonizing in design with the pergola. They will also, in time, become overgrown with climbing or rambler roses.

An interesting collection of recent rose novelties is being placed in a large bed on the west side and will constitute an interesting feature of the Garden during the coming season. This group comprises "Mrs. Andrew Carnegie," which received a gold medal at the National Rose Society Show; "Mme. Edouard Herriot," the Daily Mail rose, awarded the Daily Mail cup, valued at $5,000.00, at the Royal International Horticultural Exhibition, at London; "Irish Fireflame," and "Coronation," each awarded a gold medal by the National Rose Society. The latter variety is said to have the largest flowers of any rose grown. If it proves to be larger than "Paul Neyron," for example, it will be of unusual interest. Other novelties in the collection are the "blue rose," the "green rose," and the "rose of ten colors" — the latter having a flower so variegated as to show ten colors in the same blossom.

MAKING A ROSE GARDEN

Location.—Roses are entitled to the choicest location in a yard. Good exposure to the sun, and proper protection from prevailing winds will do much to make the rose garden a success. While a location with a full-day sun exposure is much to be preferred, it is not absolutely essential, and where a choice must be made it is best to give roses the morning sun. Beds should not be located near trees or shrubbery. Roses are heavy feeders and for their best development require an unusual amount of fertilizer; when planted near trees or shrubbery, the roots of the latter deplete the soil of nourishment, with the result that the roses suffer. If, however, planting in close proximity to trees and shrubs is unavoidable, it is advisable each year to dig a trench (about a foot wide and two or three feet deep) around the rose bed and fill with well-rotted cow manure. This procedure prevents the roots of shrubs from actually entering the rose bed.

Soil.—Roses usually do well in any good garden soil, but better results are obtained if considerable care is exercised in the preparation of the ground. Roses require a heavy, well-drained soil. To obtain this, the area to be used for a bed should be dug out to a depth of from eighteen inches to two feet and if the drainage is not good another six inches should be removed and this space filled with broken stone, brick, or old flower pots. Upon this porous stratum six inches of well-rotted cow manure should be placed and finally sufficient heavy soil to finish the bed, raising it not more than three inches above the surrounding grade. This latter layer should, if possible, be top-soil (including sod) from an old pasture. After making the bed, it should be allowed to settle for a week before the planting is begun.

Planting.—Roses may be set out either in the fall or in the spring. The spacing depends very largely upon the variety; tea and hybrid tea varieties may be planted about eighteen inches apart, but hybrid perpetuals, on account of their more vigorous growth, should be spaced at least two and one-half feet. In either case an eight-inch margin from the edge of the bed should be allowed. Where potted stock is being planted, the ball of earth should be placed with its upper surface about two inches below the soil; field grown stock may be set two or three inches lower than its former position in the nursery. The holes for receiving the plants should be large enough to admit the stock without bending or crowding the roots. The soil should be firmly packed around the roots, and the plants thoroughly watered immediately after planting. All stock should be so pruned that but two or three buds remain on each shoot—the upper bud, in each case, pointing outward.

Varieties to Plant.—Rose stock may be either grown on its own roots, grafted, or budded. It may be well in this connection, however, to call attention to certain disadvantages which attach to budded stock. In general, budded stock is more easily killed in severe winters than is stock grown on its own roots, and in addition the shoots which invariably spring from the parent stock frequently suppress the scion unless cut away.

Of the four or five thousand varieties of roses at present on the market, some growers list as many as eight hundred, but of these only a few grow to perfection in this latitude. As the result of tests in the Garden from the standpoint of perfection of blooms, profuse flowering, and general hardiness, the following list of varieties has been prepared as being particularly desirable for planting in St. Louis and

vicinity:[1] Francisca Kruger (T.), coppery yellow; Perle des Jardins (T.), yellow; Maman Cochet (T.), silvery rose; Wm. R. Smith (T.), creamy white; Admiral Dewey (H.T.), light pink; Augustine Guinoisseau (H.T.), white, tinted with flesh pink; Bessie Brown (H.T.), creamy white; Betty (H.T.), rich gold; Chateau de Clos Vougeot (H.T.), velvety scarlet (the blackest rose); Duchess of Wellington (H.T.), saffron yellow; Gruss an Teplitz (H.T.), bright scarlet crimson; Grace Molyneaux (H.T.), creamy apricot; George C. Waud (H.T.), orange-vermilion; General McArthur (H.T.), bright crimson; Killarney (H.T.), flesh white; White Killarney (H.T.), white; Lady Ursula (H.T.), flesh-pink; La France (H.T.), brightest pink; Laurent Carle (H.T.), brilliant velvety carmine; Lady Ashtown (H.T.), pale rose; Liberty (H.T.), brilliant velvety crimson; Miss Cynthia Forde (H.T.), deep brilliant rose pink; Mrs. Aaron Ward (H.T.), Indian yellow; Mad. Jules Grolez (H.T.), satiny pink; Natalie Bottner (H.T.), pure white; Frau Karl Druschki (H.P.), snow white; Gloire Lyonnaise (H.T.), white, tinted with yellow; Magna Charta (H.P.), bright rose; Mad. Chas. Wood (H.P.), bright cherry-red; Hugh Dickson (H.P.), brilliant crimson; Paul Neyron (H.P.), rosy pink (one of the largest roses); Clothilde Soupert (P.), flesh pink; Katherine Zeimet (P.), white; Mad. Norbert Levavasseur (P.), ruby-red; Orleans (P.), geranium-red; Hermosa (China), blush; Agrippina (China), fiery red; Belle Poitevine (Rugosa), rose; Blanc Double de Coubert (Rugosa), white; Conrad F. Meyer (Rugosa), silvery rose; Amy Robsart (sweet brier), deep rose; Anne of Geierstein (sweet brier), crimson; Meg. Merrilies (sweet brier), crimson; Dorothy Perkins (climber), soft light pink; Dr. W. Van Fleet (climber), rich flesh; Excelsa (climber), crimson maroon; Flower of Fairfield (climber), crimson; White Dorothy Perkins (climber), white.

Spring and Summer Care.—Before growth commences in the spring, the surplus coarse manure should be removed from the beds and the remaining fine portion turned under. Deep cultivation is not desirable—three inches being quite sufficient in beds which have not been trampled on—as the roots are likely to be injured or broken. For this purpose it is desirable to use a four-pronged digging fork, as it is less likely to injure the roots than a spade. Afterwards, and until the buds begin to develop, nothing more is necessary

[1]In the following enumeration, tea, hybrid tea, polyantha, and hybrid perpetual varieties are respectively indicated by (T.), (H.T.), (P.), and (H.P.).

except frequent stirring of the surface with a sharp-pointed rake. As the flowering season approaches, feeding with liquid cow manure should begin and should continue until the blooming season is over, after which all stimulation should cease. The liquid cow manure is conveniently prepared by adding about six pails of fresh cow manure to a barrel of water (fifty gallons), and allowing the mixture to stand a day or two before using. About one-half gallon of this infusion should be used for each plant and the application may be repeated once a week. It is safe to say that this is one of the most efficient fertilizers for roses and its continued and careful use was largely responsible for the splendid showing made by the rose garden during its first year (last season).

The Use of Magnesium.—Although it is generally believed that magnesium is poisonous to all plants, Tonk, as early as 1889, recommended a manure for roses containing sulphate of magnesium with, however, an excess of lime. Here the matter rested for twenty years. In 1909, Truffant noted the large proportion of magnesium found in the analysis of roses, and stated that soils deficient in this element produced but a weak growth of roses, but that the addition of magnesium salts brought about a marked increase of vigor and growth. The following year at the International Rose Conference, in Paris, the particular value of magnesium for roses was one of the subjects for discussion. It was declared to be indispensable and it was stated that it should always be given in the form of sulphate in doses of about five ounces to the square yard.

As the result of recent experiments at the Garden, and the experience of at least one practical rose grower of national reputation, it is believed that the following practice is correct: Attention should be called to the fact that all roses do not react alike, and some varieties not yet tested may not respond satisfactorily or may even be slightly injured by the magnesium. One should, therefore, proceed cautiously. If plants are to be watered with a solution, use nitrate of magnesium at the rate of one ounce to the gallon. This may be used once a week through the season, but if any ill effects are noted, the application should be discontinued. If the magnesium is to be applied dry, it is better to use finely powdered carbonate of magnesium which contains a certain amount of lime. This should be applied at the rate of one-third of a pound to the square yard. No immediate effect will be noticed from the application, but later, increased sturdiness and consequent richness of foliage and blossom should result.

Insects.—Half starved and otherwise neglected roses are quite susceptible to insect attacks, but not so if they are properly cared for. In St. Louis and vicinity the most serious insect enemy of the rose is probably the green fly, well known to all who have grown roses. It is a small, green plant louse, or aphid, about one-eighth of an inch in length when full-grown, and usually wingless. The body is oval and soft and secretes a sweet fluid of which ants are particularly fond. The presence of ants on rose bushes is good evidence that the aphid is at work. They usually work on the young shoots, sucking the juices with their long, slender beaks, and if unmolested quickly destroy the vigor and vitality of the rose plant. The most effective agent with which to combat the aphid is tobacco smoke, but its use out of doors is obviously connected with serious difficulties. In its place, however, an infusion of tobacco stems or leaves, quassia chips, or bitter ash, will be found effective. To prepare the solution add one gallon of water to four ounces of quassia chips, or tobacco stems or leaves, and after boiling the mixture for about ten minutes decant the liquid and add four ounces of soft soap. The latter should dissolve in the infusion on cooling. The solution so prepared may be applied either with a sprayer or with a whisk broom and should be thoroughly stirred before using. Where a sufficient water pressure is available the green fly may further be kept in check by vigorously spraying the plants from time to time as required.

Another troublesome pest of out-door roses is the rose hopper, or thrips. The insect is small, yellowish white, about three-twentieths of an inch long, and provided with a pair of transparent wings. It preys upon the leaves, working especially on the under side, the foliage assuming a sickly yellowish appearance. Their control is more difficult because of the active jumping and flying habits of the insect. Spraying the plants with water, so as to wet the under side of the leaves, and subsequently dusting them with powdered hellebore usually effects a sufficient control.

Several kinds of caterpillars prey upon the rose, sometimes causing considerable injury. All of them envelop themselves in the leaves or burrow in the flower buds. Powdered hellebore sprinkled over the plants prevents to a considerable extent the movements of the larvae, but removal is best accomplished by actually picking them from the plants.

Fungous Diseases.—The mildew is perhaps the commonest disease of the rose in this locality. Some varieties

are seldom attacked and certain locations are much more subject to it than others. The disease generally makes its appearance in the autumn, when the nights begin to grow cool; at this season, however, it works but little harm, as the plants have made their growth and the wood is nearly or quite ripened. Bordeaux mixture is a very effective agent with which to keep rose mildew in check. It is conveniently prepared as follows: Dissolve one pound of copper sulphate (blue vitriol) in a bucket of water (at least one gallon) by placing the chemical in a sack so suspended over the bucket of water as to just dip into the latter. This procedure hastens solution. When dissolved, dilute the solution to six and one-quarter gallons and add one and one-half pounds of freshly slaked lime diluted to four gallons; then pour these two together. Finally, add enough water to make twelve and one-half gallons of the mixture.

Winter Protection.—The work of protecting roses against the severe cold of the winter should be done by November 20. The earth should be heaped up around each plant to a depth of from two to three inches in order to provide drainage away from the center of the plant, and from four to six inches of straw manure should be placed over the entire surface of the bed. This treatment will protect any of the varieties previously mentioned, except the tree, or standard roses. These are budded at the crown and unless wrapped with hay or straw, freeze very easily.

Pruning.—One of the most important considerations in rose culture is that of pruning. No directions can be given which will be sufficiently explicit to enable one to know just what to do in each individual case; practical experience alone can furnish this information. But the general principles that should be observed in pruning can be readily stated. As regards tools, a pair of good shears and a pruning knife with a hooked blade are desirable. The work can be more quickly and easily done with the former, but where a very smooth cut is to be made, the pruning knife is preferable—also because it is less likely to bruise the bark.

All pruning should be done while the plants are dormant. The chief objects to be held in view in pruning roses are: the production of a symmetrical plant, and the promotion of flower bud formation. To secure these results plants of delicate habit and weak growth should be severely pruned. Vigorous growers, on the other hand, should have the shoots only moderately shortened, but the branches well thinned out. In all cases the cut should be straight across the stem in order to expose a minimum amount of wounded surface,

and care should be taken that the top bud which remains points outward. Climbing roses require no pruning beyond cutting out the very old and dead wood and shortening the laterals, except the trimming which may be necessary to make the plants conform in shape to a particular arbor or trellis.

FLORAL DISPLAY

As indicated in the last number of the BULLETIN, the cinerarias have continued to dominate the flower house during the greater part of the month. A special group of several hundred of these plants was much admired because of the intense blue color of the flowers. While the individual flowers are not so small as those of the "stellata" type, they are not nearly so large as the more intensely cultivated varieties. However, this lack of size is more than compensated for by the brilliancy of the color. Careful selection and breeding should, in a few years, make this type an important one. Good blues are rare in garden flowers and it is unusual to have such masses of fine shades as in the cinerarias shown.

In the center of the second section is a large group of the tall *Cineraria stellata,* which is attractive for the variation in color. These plants are usually later than the large-flowered types, and are only just now beginning to bloom profusely.

One of the south benches, formerly occupied by the primulas, is now filled with freesias. These are of the white or cream colored variety and are exceedingly fragrant. Although the foliage of these plants is rather inconspicuous, the flowers are borne in such profuse clusters and last so long as to make the plant well worth while for indoor growing.

On both sides of the entrance to the second section of the house, a few roses serve as a background for the beautiful flowered *Hippeastrum Jamesoni.* The flowers of this plant, which in shape and size resemble the Easter lily, are a brilliant scarlet and measure three or four inches across. They are rather constant bloomers and will probably be on exhibition for a month or more. As the season progresses these plants will gradually be replaced by other species of the same genus. In the same locality are a few plants of the monkey flower *(Mimulus tigrinus),* to which attention is called.

The latter half of the month the stocks, that are now forming a background for the cinerarias, will be removed

to make room for a representative collection of about a thousand plants of Antirrhinum, or snapdragon, in various colors.

Beginning with the first Sunday afternoon in April, the spring bulb show will be inaugurated in the flower house. This promises to be one of the most brilliant exhibitions of the season and will surpass, in the number of bulbs shown, any previous displays. There will be nearly 10,000 tulips in about 100 varieties; 4,500 hyacinths in 45 varieties; and about 600 lilies, including the Easter lily and a collection of 50 other species of Lilium. The latter, however, owing to obvious difficulties of cultivation, will not all be shown at the same time, but will be moved into the house as they come into flower. On Easter Sunday the indoor bulb display is expected to be at its best, and a week or two later, the beds outside should present a particularly attractive mass of color.

NOTES

Mr. Henry L. de Vilmorin, of the firm of Vilmorin, Andrieux & Co., of Paris, recently visited the Garden.

Classes from the Missouri School for the Blind visited the Garden on March 10 and 11, for a study of desert plants.

Mr. Charles H. Winkler, Agriculturist at the University of Texas, visited the Garden February 11.

Dr. Walter R. Bloor, Associate in Biological Chemistry, at the Washington University Medical School, addressed the members of the seminar, March 3, on "The Fats."

An interesting albino form of *Cattleya Schroederae* is at present in flower at the Garden. The flowers of this orchid are normally mauve, but this one is an almost pure albino form.

Mr. George H. Pring, in charge of orchids and exotics, addressed the School of Social Economy of Washington University, on March 11 and 18, respectively on "Evolution of the Chrysanthemum," and "Pollination of Plants." Both addresses were illustrated with stereopticon views.

Dr. Hermann von Schrenk, Pathologist to the Garden, addressed the Garden Club of Webster Groves, Missouri, on March 10. The subject of Dr. von Schrenk's address was, "Tree Planting and Diseases of Trees." On February 20, Dr. von Schrenk also spoke before the Young People's Union of the Ethical Society, on "Trees and Modern Uses of Lumber."

In continuation of the series of lectures given Monday afternoons during the fall and winter at Washington University by members of the Faculty, a spring course is to be given at the Missouri Botanical Garden by members of the Garden Staff who are likewise of the Faculty of Washington University.

April 13. "Edible and Poisonous Mushrooms," George T. Moore.

April 20. "Mushroom Growing and Truffle Hunting," B. M. Duggar.

April 27. "Our Native Wild Flowers," J. M. Greenman.

These lectures will be illustrated with living material and lantern slides. They will be held in the graduate lecture room (enter through office at Tower Grove and Botanical), and will begin promptly at 4:00 and close at 5:00 o'clock. After each lecture, those who so desire will be conducted through the new greenhouses by a special guide.

STATISTICAL INFORMATION FOR FEBRUARY, 1914

GARDEN ATTENDANCE:

Total number of visitors	2,079

PLANT ACCESSIONS:

Total number of plants donated	12
Total number of packets of seeds received in exchange	156

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	22
Total number of books and pamphlets donated	91

HERBARIUM ACCESSIONS:

By Purchase —

E. J. Palmer, private herbarium, mostly plants of Missouri, estimated to contain about	5,000

By Gift —

Miss Lily M. Cash—*Cocculus carolinianus* DC. from San Diego, California	1
J. A. Drushel—Plants of Alabama and Missouri	15
Iowa Seed Co.—*Solanum muricatum* from Des Moines, Iowa	1
John Kellogg—Plants of Missouri and Arkansas	438
Leonard Matthews—*Terminalia Catappa* L. from San Jose, Costa Rica	1
H. von Schrenk—Fungi from Texas	12
H. von Schrenk—Fungi and lichens from Jamaica	16

By Exchange —

Arnold Arboretum, Harvard University—Woody plants of North America	61
New York Botanical Garden—Plants of the West Indies	110
Iowa State College—Plants of Colorado, collected by J. P. Anderson	187
TOTAL	5,842

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Beginning with the first Sunday in April and continuing until November 30, the garden will be open Sundays from 2 P. M. until sunset. Admission free.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,

GEORGE T. MOORE.

Assistant to the Director,

JACOB R. SCHRAMM.

BENJAMIN MINGE DUGGAR,
Plant Physiologist.

EDWARD A. BURT,
Mycologist and Librarian.

HERMANN VON SCHRENK,
Plant Pathologist.

CHARLES H. THOMPSON,
Assistant Botanist.

JESSE M. GREENMAN,
Curator of the Herbarium.

MELVIN C. MERRILL,
Research Assistant.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Horticulturist.

CARL W. GARRETT,
In Charge of Main Garden and Outdoor Collections.

GEORGE H. PRING,
In Charge of Orchids and Exotics.

HENRY MEIER,
In Charge of Construction Work.

MAX SCHILLER,
In Charge of New Plant Range.

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ST. LOUIS, MO.
1914
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BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN.

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

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Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., April, 1914 No. 4

NEW COURSES IN GARDENING, HORTICULTURE, AND LANDSCAPE ARCHITECTURE

One of the declared intentions of Mr. Shaw, as set forth in the fourth clause of his will, was that "instruction to Garden pupils shall be attended to." At an early meeting of the Board of Trustees, held November 19, 1889, provision was made for instruction of this kind, and during the past twenty-four years fifty-five students have been enrolled as Garden pupils, although but twenty-five completed the prescribed course.

With the increasing facilities at the Garden for work of this kind — both theoretical and practical — it has been deemed advisable to materially strengthen the course previously offered, and to make it possible for those wishing professional training in gardening, horticulture, landscape architecture, etc., to obtain at the Missouri Botanical Garden a most complete preparation in all necessary subjects. In addition, provision has been made for those desiring to take one or more courses along special lines without being obliged to spend time in work for which they have no desire or need.

At the meeting of the Board of Trustees, held March 11, 1914, the following resolutions were unanimously adopted:

> **RESOLVED, That the action taken by the Board concerning garden pupils on November 19, 1889, and subsequently amended on March 9, 1892 and February 11, 1903, together with the action of the Board, taken at its meeting November 16, 1894, authorizing additional garden pupils which should pay a tuition, be rescinded.**
>
> **RESOLVED, That there be established the number of six scholarships for garden pupils of the Missouri Botanical Garden, each of the value of $350.00 annually, to be available on and after October 1, 1914; such scholarships to be awarded by the Director of the Garden on the results of competitive examination, to applicants between the ages of sixteen and twenty years, of good character, and possessing at least the education afforded by completing a regular high**

school course of recognized standing, or its equivalent; each scholarship to grant such privileges and be subject to such conditions as are provided below, or may subsequently be imposed by the Trustees of the Garden.

Each scholarship so conferred may be held by the original recipient for a period not exceeding three years, subject to the following conditions:

Each garden pupil shall show such progress as to satisfy the Director that the opportunities afforded are being appreciated, and from time to time will be subject to both theoretical and practical examinations. Garden pupils shall lead a strictly upright and moral life and shall be courteous and willing in the performance of all duties prescribed. Failure to meet the requirements in any of these respects shall forfeit all claim to any scholarship.

Upon the satisfactory completion of the regular garden course, the holder of a scholarship shall be examined, and on passing such examination to the satisfaction of the Garden Committee and Director, shall receive a certificate indicating the work done.

RESOLVED, That there be admitted to the garden course, in addition to those holding garden scholarships as many suitably prepared pupils as can in the judgment of the Director be adequately taught; each pupil so admitted to be charged $50.00 per year tuition and to be entitled to a regular certificate on the completion of the prescribed course and examination. It is further provided that properly prepared individuals may take a single course at a cost of $15.00 for each course extending throughout the year, and a fee of $5.00 for each course covering three months or less.

RESOLVED, That the Director be instructed to prepare regulations concerning applications for scholarships, examinations, vacations, courses of study, and such other matters necessary to properly carry out the provisions of the above resolutions and for the establishment of a garden course along the lines indicated in the Director's report for the month of February, 1914.

In accordance with the above resolutions, announcement is herewith made that the examination to fill vacancies in Garden Pupil Scholarships will be held on the first Saturday in September, in the administration building of the Garden, Tower Grove and Botanical Avenues. Applications for permission to take the examination must be sent to the Director of the Garden not later than August 15. The examinations will be designed to test the applicant's knowledge of United States history, English literature, arithmetic, algebra, the elements of botany and of one other science (either zoölogy, chemistry, physics, or physiology) to be selected by the candidate, and one foreign language, either German, French, Spanish, Latin, or Greek, according to the previous training of the applicant.

Candidates who live at places remote from St. Louis may send, with their application, the name and address of the principal or a teacher in the nearest high school who will be willing to take charge of the examination. All applications of this character must be received by the Director not later than September 1. The charges for and place of holding such an examination must be a matter of mutual arrangement between the examiner and the student. The Garden in no way can assume the slightest responsibility for such matters.

Applications from persons desirous of taking one or more courses, subject to the payment of the fees above indicated, will be received by the Director any time previous to October 1.

OFFICERS OF ADMINISTRATION AND INSTRUCTION

George Thomas Moore, A.M., Ph.D., *Director of the Garden, and Engelmann Professor in the Henry Shaw School of Botany of Washington University.*

Edward Angus Burt, A.M., Ph.D., *Mycologist and Librarian to the Garden, and Associate Professor in the Henry Shaw School of Botany of Washington University.*

Jacob Richard Schramm, Ph.D., *Assistant to the Director of the Garden, and Instructor in the Henry Shaw School of Botany of Washington University.*

Charles Henry Thompson, S.M., *Assistant Botanist to the Garden.*

S.B., Kansas State College, 1893; S.M., 1898; Instructor in the Henry Shaw School of Botany of Washington University, 1893-95; Instructor in Botany, University of Missouri, 1896-97; In charge of succulent plants, Missouri Botanical Garden, 1904-12; Collaborator, Bureau of Plant Industry, U. S. Department of Agriculture, 1909 -

William Woodward Ohlweiler, B.S., A.M., *General Manager to the Garden.*

B.S., Connecticut Agricultural College, 1903; A.M., Washington University, 1912; Missouri Botanical Garden, 1907-; Teaching Fellow, Washington University, 1912-13.

John Noyes, S.B., *Landscape Designer to the Garden.*

S.B., Massachusetts Agricultural College, 1909; Instructor in Landscape Gardening, Massachusetts Agri-

cultural College, 1909-11; with Warren H. Manning, Boston, 1911-14.

Julius Erdman, Floriculture and Plant Propagation.
Hoehere Gartenbau Lehranstalt, Koestritz, Germany, 1897; Department of Horticulture, Iowa State College, 1903-8; Florist, Colorado State College, 1909-14.

Konstantin Nicolaus Svetlikoff, A.M., Plant Breeding and Seeds.
A.M., Michigan Agricultural College, 1912; Marjinsky Agricultural School, Saratov, Russia, 1905; Connecticut Agricultural College, 1911.

Henry Michiel Biekart, Dendrology and Special Plants.
Graduate, College of Horticulture, Frederiksoord, Netherlands, 1906; Versailles, France, 1908; Zurich, Switzerland, 1910; Hamburg, Germany, 1911; Haarlem, Netherlands, 1912.

George Harry Pring, Orchids and other Exotics.
Royal Botanic Gardens, Kew, 1899-1906; Missouri Botanical Garden, 1906 -

Max Schiller, Palms, Ferns, and Floral Displays.
Palmgarten, Frankfurt am Main, 1893-1903; Missouri Botanical Garden, 1903 -

Carl William Garrett, Roses, Medicinal and Herbaceous Tracts, and Main Garden.
Missouri Botanical Garden, 1905 -

COURSES OF INSTRUCTION

First Year

1. GENERAL BOTANY. (At Washington University.) Laboratory course with lectures and quizzes dealing with the form and structure of plants, with special reference to their life processes. A brief study will be made of living plants in relation to their environment. October to June. (Schramm)

2. GENERAL FLORICULTURE. The general principles of greenhouse management; the evolution of flower forms, colors, and variations; cultural methods for the successful growing of bulbs, tubers, aquatics, vines, decorative and bedding plants, etc. October to March. (Erdman)

3. COMMERCIAL FLORICULTURE. Proper culture of roses,

carnations, chrysanthemums, violets, orchids, sweet peas, ferns, palms, and other decorative and flowering plants. Packing and shipping methods. April to September.
(Erdman)

4. ENTOMOLOGY. The gross anatomy of insects, their general classification and the various stages of their development. Special attention is given to feeding and breeding habits as furnishing a foundation for an economic consideration of the usefulness or injuriousness of insects to mankind. July to September. (Thompson)

5. ENGINEERING. Includes the drawing of specifications, cost of material and labor, distribution of time and cost, the handling of men, concrete construction, retaining walls, garden accessories, drains, sewers, culverts and road making, ditches, computations as to cut and fill, greenhouse construction, paints, etc. October to March. (Ohlweiler)

6. SURVEYING. Study of the various instruments used. Field work, including use of transit; chaining, running lines, traverses; locating details; triangulation; the compass, level and leveling rod; stadia work; bearings and azemuths; plain detail surveying and topographical work. The course includes the calculation of bearings, of areas, latitudes and departures; methods of plotting angles and traverses, with drawing of working maps. April to September.
(Ohlweiler)

7. MECHANICAL DRAWING. Problems in pencil and ink, followed by projection, shades, shadows, etc. October to March. (Noyes)

8. FREE-HAND DRAWING. Pencil, ink, and water color work with simple models, followed by more complex subjects in trees, shrubs, buildings, and landscapes. April to June. (Noyes)

9. PERSPECTIVE. Rendering in pencil, ink and water colors of architectural features and landscape plans. July to September. (Noyes)

Second Year

10. DISEASES OF PLANTS. Laboratory work with lectures on the common diseases of greenhouse and other cultivated plants and trees. October to March. (Burt)

11. PLANT PROPAGATION. Methods of propagation by seeds, cuttings, division, layering, grafting, etc., under glass and outdoors. October to March. (Erdman)

12. Forcing and Growing Methods.

(a) Flowers. Forcing of flowers under glass by heat, cold, etherization, hot water, steam, electricity, hydrochloric acid, light, darkness, special cultural treatment. October to December.

(b) Fruits. The growing and forcing of grapes, peaches, nectarines, figs, cherries, strawberries, pineapples, etc., under glass. January to March.

(c) Vegetables. The growing and forcing of lettuce, radishes, cauliflower, tomatoes, melons, cucumbers, asparagus, rhubarb, etc., under glass; sub-irrigation, soil sterilization, etc. April to September. (Erdman)

13. Plant Breeding. The principles and practice of plant breeding. Hybridization and selection. The origin of horticultural varieties. April to September. (Svetlikoff)

14. Landscape Gardening. Lectures on history and theory with discussion of modern practice; drafting, tracing, lettering, enlarging, reducing, blue prints, rendering plans, methods of filing, etc. October to March. (Noyes)

15. Pure Design. Theory, with discussion of general principles of art in relation to landscape work; the study of outdoor composition and rough sketching or photography of "landscape pictures." April to June. (Noyes)

16. Landscape Design. Lectures, practice in designs for parks, playgrounds, private estates, home grounds, formal gardens, subdivisions, etc. July to September. (Noyes)

17. American Flower Garden. Flowering trees, shrubs, perennials, and annuals used in landscape designs and private gardens in this country. Intended to familiarize the student with the variety of flowering material at his disposal, together with the facilities of various nurseries and growers in America. April to September. (Ohlweiler)

18. Soils. A consideration of the soil as a medium for root development and as a reservoir for the storage and conservation of water. Water movement, capillarity, aëration, temperature, natural minerals, soil organisms, etc. October to December. (Ohlweiler)

19. Fertilizers. Function of manure and commercial fertilizers, including a special study of nitrates, nitrites, phosphates, superphosphates, etc. A résumé of the present status of the subject with special reference to horticultural uses. January to March. (Ohlweiler)

20. DENDROLOGY. Planting, growing, and care of trees and shrubs. April to June. (Biekart)

Third Year

16. LANDSCAPE DESIGN *(Continued)*. October to December. (Noyes)

21. PLANTING DESIGN. Modern planting design with trees, shrubs, annuals and perennials in parks, private estates, cemeteries, city streets, boulevards, etc. January to June. (Noyes)

22. GARDEN ARCHITECTURE. Lectures on general architectural styles, with designs of garden seats, pergolas, sundials, summer houses, etc. July to September. (Noyes)

23. SYSTEMATIC BOTANY. Gross anatomy of plants in connection with the study of the relationships between the various groups and individuals to be found cultivated and wild; designed primarily to train the student in the ready identification of plants. The period from January to March is devoted to the study of trees and shrubs in their winter condition with special reference to the characters found in the twigs of the previous season's growth, to be used as a means of identifying the more common cultivated and native woody plants in their resting stage. January to September. (Thompson)

24. BULBS. Soils and fertilizers; culture and multiplication, both in field and greenhouse. October to March. (Biekart)

25. POMOLOGY AND SMALL FRUITS. A consideration of the various fruit areas of the United States, and of the climatic and topographical conditions influencing them; the location of orchards and fruit lands; windbreaks, tillage and moisture; planting schemes, harvesting and marketing; methods of nursery work; thinning and pruning; sprays and spraying, etc. October to March. (Ohlweiler, Biekart)

26. FORESTRY. A course intended to give a general knowledge of some of the problems of forestry, relation of the soil, atmosphere, and moisture to the development of trees; character and composition of woods; culture systems; sowing and planting; forest management, including mensuration, valuation and increment, rotation, yield, and working plans; forest protection, forest utilization, by-products, and wood preservation. July to September. (Ohlweiler)

27. ECONOMIC BOTANY. The economic uses of plants

and their products; fibers, fruits, condiments, perfumes, medicinal plants, etc. April to June. (Ohlweiler)

28. HISTORY OF GARDENS. The history, resources, and management of various botanical and private gardens throughout the world. October to December. (Moore)

29. SEED GROWING. The growing of flowers and vegetables for seed; breeding, crossing, fixing of varieties; harvesting, cleaning, and curing of seeds. April to June. (Svetlikoff)

30. TROPICAL HORTICULTURE. Cultivation of oranges, lemons, grape-fruit, bananas, tea, coffee, cacao, rubber, dyewoods, etc., as practised in parts of this country and in the tropics. July to September. (Erdman)

31. THESIS. During the second year the student will choose or be assigned some definite problem leading out of the courses given, and in the third year he will be expected to pursue this topic with the intention of presenting a thesis covering the work done.

SCHEDULE OF MORNING WORK

During the three years the regular Garden pupils will be assigned to the following departments:

1. Rose Garden.
2. North American Tract.
3. Medicinal Garden.
4. Vegetable Garden.
5. Main Garden.
6. Herbaceous Tract.
7. Exotic Department.
8. Succulent Department.
9. Palm House.
10. Orchid Department.
11. Propagating Department.
12. Floral Department.

Pupils are expected to perform all duties assigned to them, but the work will be arranged to afford as much experience and practice as possible, covering all the essential points in propagating, growing, and caring for the various collections of plants. The time devoted to each department will depend upon circumstances, and will vary from one to six months.

SCHEDULE OF AFTERNOON WORK

First Year

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Oct. to Dec.	General Botany 1	General Botany 1	General Floriculture 2	Engineering 5	Mechanical Drawing 7	Special Work
Jan. to Mch.	General Botany 1	General Botany 1	General Floriculture 2	Engineering 5	Mechanical Drawing 7	Special Work
April to June	General Botany 1	General Botany 1	Commercial Floriculture 3	Surveying 6	Free-hand Drawing 8	Special Work
July to Sept.	Entomology 4	Entomology 4	Commercial Floriculture 3	Surveying 6	Perspective 9	Special Work

Second Year

Oct. to Dec.	Plant Propagation 11	Diseases of Plants 10	Forcing Flowers 12	Landscape in History and Theory 14	Soils 18	Special Work
Jan. to Mch.	Plant Propagation 11	Diseases of Plants 10	Forcing Fruits 12	Landscape in History and Theory 14	Fertilizers 19	Special Work
Apr. to June	Plant Breeding 13	Dendrology 20	Forcing Vegetables 12	Pure Design 15	American Flower Garden 17	Special Work
July to Sept.	Plant Breeding 13	Plant Breeding 13	Vegetable Growing 12	Landscape Design 16	American Flower Garden 17	Special Work

Third Year

Oct. to Dec.	Bulbs 24	Landscape Design 16	Pomology and Small Fruits 25	History of Gardens 28	Thesis 31	Thesis 31
Jan. to Mch.	Bulbs 24	Planting Design 21	Pomology and Small Fruits 25	Systematic Botany 23	Thesis 31	Thesis 31
Apr. to June	Seed Growing 29	Planting Design 21	Economic Botany 27	Systematic Botany 23	Thesis 31	Thesis 31
July to Sept.	Tropical Horticulture 30	Garden Architecture 22	Forestry 26	Systematic Botany 23	Thesis 31	Thesis 31

FLORAL DISPLAY FOR APRIL

The display of bulb plants, which formed the chief feature in the floral house during the first two weeks of the month, in general fell somewhat short of expectations, owing to the fact that many bulbs failed to produce flowers. A similar complaint has come from many parts of the country, and it appears that the bulbs were overheated in the ocean voyage from Holland. Representatives from the Dutch bulb growers are now in this country in the interest of an adjustment. The hyacinths, however, did exceedingly well, and together with Easter lilies, calla lilies, tulips, and a large variety of antirrhinums, or snapdragons, made a splendid showing.

During the latter part of the month, and in early May, large numbers of the fancy-leaved caladiums will be shown. These plants, while having only an insignificant flower, are conspicuous because of their large, delicate, and often variously and brilliantly colored leaves. As house plants, these caladiums are little known, principally because they require an even temperature, an abundance of moisture, and but very little sunlight. In addition, a quantity of flowering plants of tobacco hybrids will be shown. The flowers of the latter plants have a tendency to close during midday, and are therefore best seen in the morning and late afternoon.

About two thousand plants of fuchsia are coming into flower and will form a conspicuous display toward the end of the month. The flowers of these plants are noteworthy because of the frequent presence within the same bloom of what might be called a "color clash,"—a characteristic seldom met with in other flowers. The Garden collection is a choice one, containing many varieties not previously shown in St. Louis. In addition, the little blue daisy *(Felicia amelloides)*, the display of which last year caused considerable favorable comment, will be shown during the month.

In front of the new conservatories, within the main entrance, and skirting the water garden and paths here and there, are thousands of blooming tulips, narcissus, etc., which, with favorable weather conditions, are expected to last until about the first week in May. Among the other outdoor plants at present in flower should be mentioned the magnolias, with their large and beautiful though somewhat ephemeral blooms.

NOTES

The class from the University of Illinois Library School visited the Garden library, March 26.

The first spring meeting of the St. Louis Section of the American Nature Study Society was held at the Garden, March 21.

On April 14, Mr. S. Alexander, of Detroit, Michigan, gave an illustrated talk before the members of the staff and graduate students on some of his recent work on sunflowers.

Dr. W. E. Garrey, Associate Professor of Physiology in the Medical School of Washington University, addressed the members of the Seminar, March 31, on "Temperature Coefficients and Nerve Action."

Dr. B. M. Duggar, Physiologist to the Garden, lectured before the faculty and students of the Iowa Agricultural College under the auspices of the "Graduate Association" on "The Vegetation and Plant Industries of Algeria."

Dr. Hermann von Schrenk, Pathologist to the Garden, delivered a series of five lectures before the members of the Department of Forestry of the University of Toronto, March 14, 15, and 16, on "Diseases of Trees and Structural Timbers."

On April 6, Mr. W. W. Ohlweiler, General Manager to the Garden, gave an illustrated lecture before the Monday Club of Edwardsville, Illinois, on "Home Gardens"; and on April 14, Mr. Ohlweiler spoke before the Eugenics Class of the School of Social Economy of Washington University, on "Plant Development."

The Science Section of the Wednesday Club held a meeting in the graduate lecture room, on April 21. The meeting was devoted to the subject of forestry, and was addressed, among others, by Mr. C. H. Thompson, Assistant Botanist to the Garden, who spoke on "Pests of Forest Trees." After the meeting, the members were conducted through the Garden by Mr. Thompson.

In the February number of the BULLETIN attention was called to an albino form of the Cattley orchid *(Cattleya Schroederae)*. Since that time other plants of the same species have come into flower, one of which is bearing a peculiarly abnormal flower. The latter possesses, in addition to the parts normally present, two sepals, one petal, two anthers, eight pollen masses, and two stigmas.

All of the lectures in the spring series of the Washington University Lecture Course have been delivered: On April 13, Dr. George T. Moore, Director of the Garden, spoke on "Edible and Poisonous Mushrooms"; on April 20, Dr. B. M. Duggar, Physiologist to the Garden, spoke on "Mushroom Growing and Truffle Hunting"; and on April 27, Dr. J. M. Greenman, Curator of the Herbarium, delivered the concluding lecture, his subject being "Our Native Wild Flowers."

The first number of the "Annals of the Missouri Botanical Garden" appeared in March. As stated on the cover, this publication is "A Quarterly Journal containing Scientific Contributions from the Missouri Botanical Garden and the Graduate Laboratory and Faculty of the Henry Shaw School of Botany of Washington University in affiliation with the Missouri Botanical Garden." In the introduction it is explained that the volume hitherto known as the "Annual Report" and published each year from 1890 to 1912, has been discontinued. Scientific papers, which formerly constituted so large a part of the volume, are now printed in the ANNALS; and the Reports of the Officers of the Board of Trustees and of the Director, formerly also published in the Annual Report, now appear in the January number of the BULLETIN. Besides the introduction, the first number contains four scientific articles, as follows:

"The Effect of Surface Films and Dusts on the Rate of Transpiration. B. M. Duggar, *Physiologist to the Garden,* and J. S. Cooley, *Rufus J. Lackland Fellow in Botany.*

"Some Pure Culture Methods in the Algae." Jacob R. Schramm, *Assistant to the Director.*

"The Identification of the Most Characteristic Salivary Organism and its Relation to the Pollution of Air." August G. Nolte, Late Graduate Student at the Garden.

"The Polyporaceae of Ohio." L. O. Overholts, *Rufus J. Lackland Fellow in Botany.*

STATISTICAL INFORMATION FOR MARCH, 1914

GARDEN ATTENDANCE:

Total number of visitors	5,177

PLANT ACCESSIONS:

Total number of plants received in exchange	11
Total number of packets of seeds received in exchange	1,235

PLANT DISTRIBUTION:

Total number of plants distributed in exchange	331

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	47
Total number of books and pamphlets donated	110

HERBARIUM ACCESSIONS:

By Purchase —	
E. Bartholomew — "North American Uredinales," Cent. IX, X, Nos. 801-1000	200
Geological Survey of Canada—Plants of Canada	63
R. Friedländer & Sohn—Zenker's plants of Kamerun	383
By Gift —	
B. F. Bush—Plants of Indiana, Minnesota, Virginia, and District of Columbia	23
J. A. Drushel—Plants of Alabama and Missouri	25
By Exchange —	
Charles C. Deam—Plants of Indiana	138
U. S. National Museum—"American Grasses"	200
TOTAL	1,032

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Beginning with the first Sunday in April and continuing until November 30, the Garden will be open Sundays from 2 P. M. until sunset. Admission free.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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Engineer.

G. H. PRING,
Orchids and other Exotics.

M. SCHILLER,
New Conservatories.

K. N. SVETLIKOFF,
Plant Breeding and Seeds.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. II MAY, 1914 No. 5

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ST. LOUIS, MO.
1914

PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:

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Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., May, 1914 No. 5

THE FLEUR-DE-LIS, OR IRIS

In the coming Pageant and Masque of St. Louis, the symbol of French royalty, the fleur-de-lis, will doubtless be much in evidence. Although appearing in many conventional forms, especially in decorative designs, it is probably not generally known that the flower represented by the fleur-de-lis is usually believed to be not the lily, as the name would seem to indicate, but the common flag, or iris.

The iris figures prominently in many of the very early writings on so-called medicinal botany. It was not the flower, however, which led the early writers to lay so much stress on this plant, but rather the rhizome, or underground stem, to which were attributed a host of singular medicinal virtues. The use of the stems for the most varied ailments was attended by solemn ceremonies, and in time a mysterious or even divine influence became ascribed to the iris. This supposed influence has given rise to numerous traditions or legends only one of which can be given here, this one having been selected because it is frequently referred to as offering an explanation of the manner in which the fleur-de-lis became the distinctive bearing of the Royal family of France.

In the encounter between the Franks under Clovis and the West Goths under Alaric II, at Voulon on the banks of the Vienne, in 507, tradition tells us that the Franks were at first unable to cross the river owing to the depth of the water. A deer, however, frightened by the clatter of arms, instinctively ran to the river's brink and crossed safely at a shallow place, thereby pointing out a ford to the Franks. At the ford Clovis observed the river iris growing in abundance and, recalling the marvelous properties attributed to the plants, saw in the aid of the deer an act of divine intervention. As a pledge of his future victory, the leader dismounted and plucked one of the flowered stems, and then proceeded across the river. The march against the West Goths proved to be a triumphant one

indeed, and Clovis, believing that the victory was due to the influence of the iris, caused the flower to be executed in gold and velvet, and henceforth regarded the iris as the symbol of victory.

The distinctively French character of the early history of St. Louis attaches to the iris a peculiar interest and importance in the Pageant and Masque, and no single flower perhaps so deserves to be called the flower of St. Louis as does the iris. In recognition of this fact the Garden is showing during the Pageant week, and for some time after that, a large collection of the various forms of the iris. To the already representative Garden collection many new forms have been added for this occasion. These have been grown in pots and will be shown in the greenhouses, where the variation in color and form can be observed more easily.

The Flower.—Although the early interest in the iris centered chiefly in the supposed medicinal properties of the plant, it was not long before the iris began to be cultivated for its flowers. Few plants are more extensively and generally used in gardening than the iris, not only because of the beauty of the flowers, but also on account of the hardiness and persistence of the plants under varying conditions. The flower itself presents some interesting modifications. The parts of the flower are joined together in the form of a tube or cylinder, and while this structure varies in length it is always present. At some distance above the ovary the tube gives rise to six petal-like segments, of which the outer three, commonly called the "falls," bend downward and the inner three, termed the "standards," remain erect and usually converge at the top. The central style column, which is surrounded by the six segments, also branches into three petal-like divisions, each of which bears a stigmatic lip on the under side near the upper extremity. Above the point of insertion of the stigmatic lip each style branch splits into two stigmatic crests. The style branches are usually arched and concave on the under side, thus affording protection to the stamens which lie directly beneath them. The ovary is divided into three elongated cells, corresponding to the three style branches, and the seeds are attached to a central column. While some species of iris show certain minor modifications, the account just given is generally applicable to the flowers of all forms.

Rhizomatous and Bulbous Irises.—By far the most commonly grown species of iris are those provided with rhizomes or root stocks — thick, elongated, root-like stems growing almost on top of the ground. There are, however, certain

species of iris which grow from a small bulb and require a treatment not essentially different from that employed with tulips and other spring-flowering bulbous plants. The Spanish iris is an example of the latter type, whereas the Japanese and German irises are examples of rhizomatous forms.

Cultivation.—Irises are native to, and very widely distributed in, the north temperate zone, no species having been found south of the equator. Our own climate, therefore, is well adapted to the growing of irises and the very generally successful growing of these plants indicates that their culture is not attended with any serious difficulties. A few suggestions as to cultivation may, however, prove serviceable. Irises in general are sun-loving plants; a few species thrive in half shady localities, and even the so-called German iris and certain others will live in shady situations but flower more profusely when removed to sunny exposures.

Those species known as "Pogonirises," which have a distinct beard on the "falls," usually grow best on a heavy, well-drained limestone soil, exposed to abundant sunshine. Those forms known as "Apogon irises," which have no beard on the "falls," or at most only a very slight pubescence, do better in a light alluvial soil rich in humus. During the winter irises should not stand in water, in fact an abundance of water is necessary only just before and during the flowering period. After the blooming season, most irises appreciate a period of rest, a condition which is usually best induced by withholding the water supply. The Japanese irises, however, do not require this period of rest and to this group other individual species could be added.

The selection of the proper habitat for irises, especially as regards the water supply, is, as indicated above, important and it is fortunately possible to differentiate between the dry and wet-soil species by the fact that the leaves of the latter, when held up to the light, show a number of minute blackish spots, whereas those of the former appear uniformly green. In dealing with new plants it is obvious that this character may be extremely serviceable in indicating the proper choice of soil and position — the presence of the spots, for instance, always indicating that the plant is a native of marshy ground.

The usual practice of moving perennials in the fall should not be extended to the iris. At this time the main roots have already produced their lateral branches and these are broken or injured in the removal, and the plant does not subsequently make good progress. The principal roots grow

down into the ground their full length without branching. If, therefore, the plants are taken up when the primary roots are still short and without lateral branches, transplanting, if carefully done, can be carried out with little or no injury. It is even better, however, to transplant before the new roots have started to grow from the rhizome, but in order to do this the plants must be moved immediately after the flowering season is over.

It is important that the rhizomes be kept free from overgrowths of other plants. Any smothering of this kind is almost certain to result in decreased vigor in the plants and a scarcity of flowers in the next season. All dead leaves that are easily detachable should be removed from the plants, but the practice of cutting back the green leaves because the ends have begun to turn yellow should not be indulged in. In the leaves is produced the food which later is stored in the rhizomes, and any decrease in the total leaf surface carries with it a corresponding reduction in the available food supply for the next season's growth and flower production. The iris, like most other plants, is subject to certain diseases, but of these none have assumed any great importance in and about St. Louis, and this phase of iris culture need, therefore, not be considered here.

HORTICULTURAL GROUPS OF THE IRIS

German Iris.—These irises, all of which are hardy, are usually given as varieties of *Iris germanica.* However, the latter species has but very few varieties, the plants given as varieties usually being hybrids of *Iris germanica* with a number of other species and garden forms, all of which are very closely related to the above species. The varied parentage of the German irises accounts for the great variety of color in these forms, colors which range from pure white through all shades of mauve to blue and dark purple, and not infrequently flowers marked with yellow occur. The blossoms are large and handsome and are borne on stout, erect, branched stalks, much exceeding the clumps of spreading leaves. The larger part of the Garden collection in the greenhouses will consist of varieties of the German iris.

Japanese Iris.—Although far outnumbering the German irises, the Japanese varieties offer none of the difficulties as regards parentage that the German irises do. *Iris Kaempferi,* sometimes known as *Iris laevigata,* is the only known parent of this group. The Japanese forms usually flower later than those of the preceding group, and while the color of the flowers also ranges from white to dark purple the

form of the flower itself is quite different. The significance of "standards" and "falls" is more apparent in the German iris than in the Japanese forms. In the latter the standards have a more flattened appearance and give the flower a much broader appearance generally. Some of these irises will, no doubt, be in flower out of doors at the time of the Pageant.

Dwarf Iris.—The members of this group are truly distinctive and are among the very first to flower. The borders of some of the beds in the Garden, particularly in the vicinity of the Linnaean House, have been composed for many years of the dwarf species, *Iris pumila.* The colors are usually pale blue, blue, and deep purple.

Bulbous Iris.—These irises are grown from bulbs planted out in the fall, as are tulips, narcissus, and other spring-flowering bulbs. Perhaps the best-known forms in this group are the English and Spanish irises, known chiefly for their brilliant colors, strong contrasts, and profuse flowering. To attain the best results the bulbs should be lifted after flowering and ripened previous to replanting in the fall.

GARDEN COLLECTION FOR THE PAGEANT

German Irises (in the greenhouse).—"Aurora," "Admiral Togo," "Alvelrea," "Brooklyn," "Charles Dickens," "Darius," "Dr. Parnet," "Fragrans," "Agamemnon," "General Grant," "Harlequin Melanais," "Hokanum," "Honorable," "La Tendre," "Lady Stumpp," "Mrs. Charles Wheeler," "Gold Bond," "Pauline," "Pres. Thiers," "Pallida Speciosa," "P. Bernot," "Queen of the Gypsies," "Montauk," "Sappho," "Souvenir," "Victory," "Virgil," Mrs. H. Darwin," "Madam Chereau," "Pallida Lavender Queen," and "Florentina Alba."

Spanish Irises (out of doors).—"Alexander v. Humboldt," "Belle Chamoise," "Blanche Superba," "British Queen," "Darling," "Excelsior," "King of the Blues," "Marie," "Prince of Orange," and "Snow Ball."

THE CYCAD AND CONIFER GARDEN

The large consumption of soft coal in St. Louis has made the successful out-of-door growing of evergreen conifers almost impossible. Furthermore, there has not heretofore been a suitable place in which to display the Garden's large collection of cycads. To meet both of these needs, the north wing of the new conservatories is being converted into a Japanese-like garden, the type of garden into which

conifers and cycads fit best. The Japanese art of gardening, as practised at the present time, is the result of centuries of horticultural effort so influenced by religious beliefs that every part of the garden has come to have some special significance. Strangely enough, rocks and stones are apparently of as much importance in such a garden as plants. Among the latter, however, which are characteristic of Japanese gardens, should be mentioned the Japanese iris —without which no Japanese garden can be truly said to be complete, the cycads, and the conifers. For the time being the indoor collection of irises referred to elsewhere in the BULLETIN will also be shown in this house and will add to the general Japanese effect produced by the little pools, the walks of stepping stones, the arched bridges, and the miniature mountains.

Entering this wing from the fern house and viewing the whole garden from this point of vantage, a striking effect of distance, accomplished wholly by the plantations, will be noticed. All the larger trees and plants and the higher elevations are in the foreground, with the smaller specimens and the lower elevations in the distance. Even the stones in the path diminish in size as the path approaches the farther end of the house. The windings of the walks, while apparently aimless, have a real significance to the Japanese.

Five distinct elevations characterize the garden, two of which are on either side of the center line, the fifth one, known as the "Sunset hill," being on the line and at the west end of the house. The large stone at the base of the Sunset hill and near the walk is called the "Moon-shadow stone." To the east of the small bridge in the west end of the garden is a small island upon which is a stone known as the "Worshipping stone." This little island is connected with the shore by a single rock and almost opposite the latter is another flat stone, known as the "Seat-of-honor stone." The "Guardian stone" is on the right side of the cascade and can easily be seen from the steps upon entering the garden. The "Water-tray stone" is on the south side of the small pool and not far from the cascade. A stone near the first bridge is the "Perfect-view stone."

The Japanese garden has aptly been described as a landscape in miniature, and in order to enjoy perfectly its different parts one must imagine that the mounds of earth are in reality rather good-sized hills, that the small stream is a river, and that the small pools are mountain lakes. The dwarfed trees and the well-grown cycads, too, are important, because they represent years of patient effort.

The garden has been constructed during the month and while the general effect will be satisfactory almost from the first, the atmosphere of antiquity so much desired in Japanese gardens will not be completely realized until some time afterward.

FLORAL DISPLAY

Floral Display House.—During the month the collection in the floral display house has consisted principally of large quantities of hydrangeas, comprising a great many specimens of the ordinary "Otaska" forms. More conspicuous, however, have been the new French hybrids which were so much admired last year and which have measured up to all that has been claimed for them as regards color and beauty of the flowers. These new hybrid forms unquestionably furnish an important addition to the flowering material suitable for greenhouse work. This display has been arranged in the center and on either side of the entrance to the west wing of the floral display house, and presents a massive effect from the landing at the head of the steps. On the side benches are displayed large quantities of the blue daisy (Felicia), snapdragons, or antirrhinums, and calceolarias. The collection of the latter has been much improved by the addition of a considerable number of new hybrid forms kindly presented to the Garden by Mr. Robert Shore, Gardener of the Russell Sage Conservatory of Cornell University. The most notable of these are the bright yellow forms, the flowers of which, while not large, are exceedingly numerous and brilliant. In the east wing of the display house large numbers of fancy-leaved caladiums and quantities of white and yellow marguerites are being shown.

These displays will be followed during the month by a large collection of Gloxinias (about 1,200 plants) and one of tuber begonias, numbering 850 plants.

Orchid House.—A very considerable number of orchids are in flower, but the collection of blooming forms is still dominated by the mauve-flowered cattleyas of the *C. Schroederae* type. Other interesting forms are the wax orchid *(Chysis bractescens)*, with cylindrical pseudo-bulbs and pendant spikes of thick, white, wax-like flowers, O'Brien's orchid *(Epidendrum O'Brienianum)* with long racemes of light scarlet flowers, the small chain orchid *(Platyclinis latifolia)* and the large-flowered chain orchid *(Coelogyne Swaniana)*, in both of which the flowers are so arranged as to resemble the links in a chain. The specimen of *Polystachya affinis*, imported from the Congo region in 1906, is interesting because of its light, yellowish-brown flowers and

curiously flattened pseudo-bulbs. Other forms in flower are the bird's bill orchid *(Oncidium ornithorynchum)*, purple-flowered orchid *(Broughtonia sanguinea)*, fragrant orchid *(Lycaste aromatica)*, the yellow-flowered *Oncidium ampliatum*, the white-flowered *Xylobium concavum*, and the "midget" orchid *(Pleurothallis tenera)*. The latter is the "Tom Thumb" of the Garden collection, being fully grown in a pot not much larger than a hen's egg.

Aroid House.—Several interesting aroid plants are in flower and fruit, the fruit in several cases being far more noteworthy than the small and usually inconspicuous flowers. *Palisota Barteri*, and *Anthurium Bakeri*, for instance, bear heads of inconspicuous flowers, but later produce striking groups of bright scarlet seeds. The same holds true in *Anthurium scandens*, but here the fruit is pure white, resembling that of the mistletoe. A small group of bertolonias, bearing light pink flowers, and the rare *Columnea Schiedeana*, a native of Mexico, with dark red, tubular flowers and variegated, velvety leaves, are in flower. The Indian tessamine, or rain-bow flower *(Ixora coccinea)* is still in full bloom, the heads of scarlet flowers being extremely attractive. The aroids in general require a high temperature, and cannot, therefore, be shown in the floral display house, which is maintained at a much lower temperature.

NOTES

On May 13, the wives of the delegates to the Undertakers' Convention and those of the delegates to the Convention of the Railway Development Association visited the Garden and were personally conducted through the grounds by Mr. Thompson, Assistant Botanist to the Garden.

A party of over two hundred, consisting of the delegates (and members of their families) to the Convention of the Brotherhood of Interurban Trainmen, visited the Garden on May 15.

Mr. W. W. Eggleston, of the Bureau of Plant Industry of the U. S. Department of Agriculture, Washington, D. C., visited the Garden on May 11, and spent the day consulting the herbarium.

Mr. W. W. Ohlweiler, General Manager to the Garden, spoke before the St. Louis Branch of the American Pharmaceutical Society, at the St. Louis College of Pharmacy, May 15, on "A Modern Herbal Garden."

A large shipment of plants native of New Hampshire has recently been received and will prove especially interesting

to those familiar with the New England flora. Among others, the collection embraces in quantity iris, cardinal flower *(Lobelia cardinalis), Lobelia syphilitica,* Myrica, Caltha, Cimicifuga, Mertensia, *Azalea nudiflora,* and *Kalmia angustifolia,* besides numerous other species and a large number of native ferns and an especially fine collection of cypripediums.

Dr. E. A. Burt, Mycologist and Librarian to the Garden, has returned from the east, where he spent about six weeks in the study of fleshy fungi in the herbaria at Harvard University and the New York State Museum at Albany. Besides making a careful study of many rare types of fungi, Dr. Burt arranged an exchange whereby the Garden herbarium comes into possession of about three hundred valuable specimens of fungi.

An interesting hybrid slipper orchid, presented to the Garden by Mr. D. S. Brown, of Kirkwood, Mo., is blooming, the flower spike, which is several feet in height, bearing yellowish-brown flowers. This garden hybrid was raised by Mr. Brown from the parents *Selenipedium calurum* and *S. Sargentianum,* and named by him "Selenipedium Brownhurst."

On April 29, the Committee for Grading Structural Timber, of the American Society for Testing Materials, held a meeting in the Museum building at the Garden. Dr. Hermann von Schrenk, Pathologist to the Garden, is Chairman of the Committee. One of the features of the meeting was an extensive exhibit of the various species of southern pines.

STATISTICAL INFORMATION FOR APRIL, 1914

GARDEN ATTENDANCE:

Total number of visitors	40,147

PLANT ACCESSIONS:

Total number of plants received in exchange	69
Total number of packets of seeds received in exchange	616

PLANT DISTRIBUTION:

Total number of plants distributed in exchange	2,895

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	26
Total number of books and pamphlets donated	35

HERBARIUM ACCESSIONS:

By Purchase —

A. D. E. Elmer—Plants of the Philippine Islands	825
H. Sydow—"Fungi exotici exsiccati," fasc. V, VI, Nos. 201-300	100
Th. Oswald Weigel—Dr. A. v. Hayek's "Centaureae exsiccatae criticae," fasc. I, II, Nos. 1-100	100

By Gift —

S. Alexander — Photographs and specimens of Michigan plants	61
H. H. Bartlett—Plants of the Southern States	43
J. A. Drushel—Plants of Ohio and Missouri	13
W. G. Farlow—Fungi, chiefly from New Hampshire	57
W. H. Emig—*Sphaerocarpus Michelii* Bellardi from Missouri	1
J. M. Greenman—Colored plates of flowering plants and ferns	137
A. M. Huger—Plants of North Carolina	49
A. M. Huger—Plants of Georgia	33
A. T. Hudelson—*Forestiera acuminata* (Michx.) Poir. from Missouri	1
Mrs. H. C. January—*Asimina triloba* Dun. from Missouri	1
G. H. Pring—Teratological flowers of *Cattleya Schroederae* Rchb. f.	1
J. R. Schramm—*Sphaerocarpus Michelii* Bellardi from Missouri	1
H. von Schrenk—Southern pines	62
A. B. Seymour—Fungi from New England	22
R. Thaxter—Fungi from Florida	47

By Exchange —

North Dakota Agricultural College — Plants of North Dakota	227
TOTAL	1,781

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Beginning with the first Sunday in April and continuing until November 30, the Garden will be open Sundays from 2 P. M. until sunset. Admission free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to November 1, starting from the main gate at 3 o'clock. Other trips may be arranged for by special appointment.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

The Garden will be open all day May 30, Decoration Day.

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INTERIOR OF ONE OF THE HOUSES CONTAINING SUCCULENT DESERT PLANTS

Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., June, 1914 No. 6

SUCCULENT DESERT PLANTS

The Garden collection of succulent desert plants, as it stands to-day, probably represents the most complete assemblage of genera and species of this kind to be found in this country, and takes high rank with similar collections of the world. In the early history of the Garden, St. Louis was on the border of the vast American desert, which lay to the west and southwest, connecting directly with the more arid regions of Mexico. Early explorations of this region and government and railroad surveys of the western country had their starting points in St. Louis. With these expeditions traveled men trained in the various sciences, and in some instances botanists were employed. Many of the botanical specimens obtained on these trips were consigned to Dr. George Engelmann, at that time the principal botanist of the Mississippi Valley. A close friendship, engendered by a love of plants, sprang up between Mr. Shaw and Dr. Engelmann, and it was through the latter that many of the plants found a permanent home in Mr. Shaw's garden. This is especially true of the succulent plants from the arid regions of the southwest. With the Engelmann contributions as a nucleus, the collection of desert succulents has been steadily increased; interest in these plants of our own country created an interest in desert plants of other countries until now the display on exhibition at the Garden includes representatives from practically every arid and semi-arid region of both the New and the Old World.

It may be well to explain briefly what is meant by the term succulent desert plants as used in this connection. Many plants thrive and are conspicuous in deserts during the brief rainy season, but disappear almost completely during the long, dry period. These are excluded from the present discussion, as are a very large number of plants indigenous to the deserts of the eastern hemisphere, notably the Sahara, which are rush-like and exceedingly tough and coarse. The plants here referred to are those fleshy, suc-

culent forms, typified by the cacti, which are so characteristic a part of the American desert landscape.

These plants distinguish themselves not only by their peculiar habitat, but also by their often strikingly grotesque forms, which have earned for them the appellation of "cartoons of the plant world." In fact, these plants are so peculiar in their form and structure that they stand out prominently as a distinct group. Moreover, wherever desert conditions are encountered in America, plants of this type are almost invariably met with, and it becomes of interest, therefore, to inquire into the forces which are operative in these desert regions in bringing about such modifications and adjustments.

A small annual rainfall (amounting in many of the arid and semi-arid regions of the southwest to not more than 8-15 inches, whereas that in the vicinity of St. Louis amounts to about 37 inches) usually coupled with high temperatures and an excessive rate of evaporation, due to the dry, warm atmosphere, are perhaps the most obvious characteristics of most desert regions. In attempting an analysis of plant life under these conditions it is at once evident that the question of water supply is of paramount importance.

Generally speaking, practically all of the water absorbed by plants is taken up by the roots. In addition to absorbing water, the plant is constantly giving off, or transpiring, water vapor to the air from the aërial parts, notably from the leaves. The speed of this evaporation from the plant is governed, other things being equal, by the same factors which apply to evaporation from free water surfaces, namely, temperature, area of water surface exposed, and frequency of change of the surrounding atmosphere. It is of importance, therefore, to call attention here to the fact that the question of water supply in plants naturally divides itself into two propositions, (1) the amount of water absorbed by the roots, and (2) the amount of water transpired, or conversely stated, the amount of absorbed water which is conserved.

It is popularly supposed that the roots of desert plants are of great length and that they penetrate the ground to great depths in order to reach the water-containing strata during the long, dry seasons. While this may be true to a certain extent in the non-succulent desert plants, especially those of the Old-World desert regions, it is notably not true for the fleshy, succulent plants — the plants which are to be considered in the present discussion. In these the roots, at least those which are actively concerned with water absorp-

tion, are uniformly near the surface, frequently not penetrating the soil more than one or two inches, though extending horizontally for long distances. While the length of time during which these strata contain sufficient moisture for absorption by roots varies greatly in different arid and semi-arid regions, it is probable that the period in general does not much exceed six weeks following the rainy season. Those plants with shallow absorbing root systems, therefore, are limited to a very short "absorbing season," a season which represents in most cases but a small fraction of the year.

It is obvious, therefore, that the continued life of succulents is not to be explained on the basis of a constant and uninterrupted absorption of water. The roots of these plants seem rather to be adapted for the prompt absorption of water at the time of the seasonal rains, and in this they are not infrequently aided by the rapid production during the wet season of additional absorbing roots—temporary roots which are shed as soon as the dry season approaches, much as leaves are. On the other hand, the success of the succulents in the desert is due in large part to the storage of large quantities of water, and to the careful guarding against excessive transpiration with consequent conservation of much of the absorbed and stored water. This economy is so effective that the plants are able to live from one rainy season to the next on the water gathered and stored during the short, rainy period. Indeed, there is evidence to show that this economy is more stringent than is actually necessary for the preservation of life, as plants have been observed to live for several years without absorption of water, whereas in the desert they usually have at least two periods of absorption during the year.

As regards the storage of water, this is usually effected in extensive areas of tissue, composed of large water-storage cells. Succulency, therefore, is a term applied to plants provided with a conspicuous amount of such water-storage tissue. This tissue may appear either in the stem or in the leaves, or in both, and as a result give rise to fleshy, or succulent, stems and leaves. In the typical desert cacti this tissue appears almost exclusively in the thick, fleshy stems, although in the century plants and other forms it is conspicuously present in the leaves. The development of these water reservoirs, however, does not alone insure a constant water supply to the plant. A necessary accompaniment is the prevention of excessive evaporation, or transpiration. This conservation is effected first of all by a reduction in the total

amount of plant surface exposed to the atmosphere from which evaporation may take place, and has resulted in the cacti in the almost complete suppression of leaves, the thick, fleshy stems which remain serving to combine maximum bulk with a minimum of surface exposure. Even in those cases where leaves appear, they do not remotely resemble those of our ordinary plants and in most cases are small and scale-like and soon wither and fall away.

A further safeguard against excessive transpiration exists in the relatively impervious layer which covers the entire surface of desert succulents. Although this mantle is interrupted at intervals by breathing pores, or stomata, it is otherwise quite impervious to water. It has been shown by experiment that a melon-cactus (Echinocactus), an almost globose leafless form in which the reduction of surface has proceeded to an extreme degree, transpires only about one five-thousandth as much water as a plant of equal weight of the Dutchman's pipe *(Aristolochia Sipho)*, a climbing plant bearing an abundance of thin, broad leaves and therefore exposing a relatively enormous transpiring surface.

These striking adjustments to the arid conditions of deserts are well illustrated in the specimens in the Garden. In the accompanying plate some of the cacti in the collection are shown and it will be observed that in nearly all of them great bulk is combined with a minimum exposure of surface. Among others in the Garden may be mentioned the cylindrical-stemmed opuntias and the flat-stemmed species ("prickly pears," or "Indian figs") of the same genus. In these the stems are considerably enlarged, due to the presence of a great deal of water-storage tissue, whereas the leaves are much reduced, awl-shaped bodies which soon wither and fall. The members of the genus Cereus have developed a comparatively large columnar stem which is leafless, or, in rare instances, provided with a few rudimentary leaves. The species of Echinocactus (hedgehog cactus) have much shorter, and proportionately thicker, stems than those of Cereus, forming spheroidal plants entirely destitute of leaves. Similar globose forms are to be found in the genus Mammillaria, native of the United States, Mexico, and the West Indies, in Melocactus, indigenous to the West Indies and Central America, and in Echinopsis, at home in South America.

Cacti are strictly American plants, growing in the arid or semi-arid regions of both continents from the southern part of British America to Argentine and Paraguay. For the most part they are of little economic value, although

occasionally some of the columnar forms of Cereus are used in Mexico as hedge plants. A few forms of Cereus and a number of opuntias produce a very palatable fruit which is eaten raw or made into preserves. In emergencies the young growths of prickly pear have been used as food for stock. As regards the spineless forms, these have in all probability been unduly proclaimed as excellent stock food and as the solution of the problem of desert reclamation. A few members of the cactus family produce drugs which have a marked action on the nervous system, the "mescal button," or "dumpling cactus," yielding an alkaloid with a pronounced effect on the optic nerve. Many cacti are well worth cultivation as ornamental plants, some of them producing very attractive flowers. Among these may be mentioned the various forms of night and day-blooming cereus, "queen of the night," and species of the genera Phyllocactus, Echinopsis, and Epiphyllum.

From what has been said it might appear that all cacti are succulent. There are, however, a few forms, like the pereskias of the subtropical regions of America with a moderate rainfall, which have relatively small stems and abundant thin-leaved foliage. Forms more or less intermediate between the leafy pereskias and the succulent, leafless, desert cacti, exist in the species of Pereskiopsis, growing in parts of Mexico having an annual rainfall which is intermediate between that of the desert and that of the regions to which the pereskias are indigenous. Representatives of both of these leafy genera are included in the Garden collection and serve to emphasize the adjustment to extreme conditions which has taken place in the succulent desert-inhabiting species. Especial attention is called to the pereskias, several good specimens of which are at present in flower in one of the desert houses.

The succulent euphorbias, of which the Garden has a large collection, almost parallel the cacti in fantastic forms of growth, and to an untrained eye the members of the two groups appear strikingly alike. The families, however, are widely separated. Euphorbias are to be found in the torrid and temperate regions of both hemispheres, the fleshy forms, however, being for the most part restricted to the arid regions of Africa, Arabia, and India, though a few small species occur in Texas and Mexico. The remarkable coincidence of form met with in the cacti and euphorbias may in part be due to the similar climatic and soil conditions to which they are exposed in their respective arid habitats. Like the cacti, the euphorbias have little economic value; a few are used

as hedges, others produce drugs, and still others yield rubber. A number of them contain a poison in the milky sap which is used to some extent as a fish poison.

Another family which contains succulent desert species, but which is only very distantly related to the two previously mentioned ones, is that of the asclepiads, succulent forms of which occur in the arid regions of Africa. The brilliantly colored flowers of green, yellow, or purple usually have a putrid odor and it is for this reason that they have been termed "carrion flowers." In this group, again, the fleshy stems and reduced or obsolete leaves are evident, though, as in the preceding groups, there are a few instances in which the foliage is fleshy. Conspicuous among the asclepiads are the stapelias. These have low-growing leafless stems, approximating the size of a man's finger, which grow in clusters. They are sometimes called "finger cacti," and again, "star cacti," the latter name referring to the flowers, which are in the shape of a five-pointed star. The term cactus, of course, is not applicable here, but it serves to indicate how strikingly similar in form these various desert plants are, though belonging to such widely separated families. One of the most interesting of these asclepiads in the Garden collection is the parachute plant *(Ceropegia hybrida)*, several good specimens of which are at present in flower. Of especial interest are the curiously shaped, greenish, parachute-like flowers to which the plant owes its name. Another species, *Ceropegia stapeliaeformis*, with dark-brown flowers, is also in flower. In the latter, however, the resemblance to a parachute is not so striking.

Of the other great group of succulent desert plants, those with relatively small stems and thick, fleshy leaves, probably the most gigantic representatives are to be found among the agaves, or "century plants." In most of the many forms of this genus the stem serves merely as a point of attachment for the very fleshy, water-storing, and drought-resisting leaves. This family is strictly indigenous to the New World, extending from southwestern United States to the highlands of Bolivia. Its members are most abundant in Mexico where they play a considerable rôle in the life of the native, furnishing him with food, drink, clothing, and shelter. "Pulque," the milder beverage of the Mexican, and "mescal" and "tequila," the stronger ones, are made from some of these plants. Others produce good grades of fiber which is manufactured into various kinds of cordage and coarse cloth.

It may be well to state here that the name century plant is misleading in that it is highly improbable that any of

these plants ever live to be a hundred years old; in fact, very few live for more than half that time. The agaves are peculiar in that they flower but once during their entire existence. From infancy to maturity the plant continues to put out new and larger leaves in which quantities of water and reserve food materials are stored. At maturity a large flower stalk, in appearance not unlike a fresh sprout of asparagus, is produced from the center of the rosette of leaves. All the reserve material that has been stored in the leaves contributes to the formation of this stalk, its flowers, and its fruits, and by the time the seeds are ripe the leaves are withered and the plant is dead.

Among the genera of smaller plants with leaves not unlike those of agave should be mentioned Dyckia, one of the South American genera of bromeliads, Aloë, and Haworthia—belonging to the lily family and a native of Africa. Another genus with fleshy-leaved species is Mesembryanthemum, of South Africa. Some members of this group have thick tongue-shaped leaves, and others are so peculiarly constructed that they have been called the "tiger's jaw." In others, again, the leaves grow together in such a way as to give the whole plant the appearance of a small puff ball. Echeveria, of Mexico, and Sempervivum, of the Mediterranean region, commonly known as "hen and chickens," have short, thick leaves arranged in a close rosette. Dudleya and Stylophyllum, of the coast of California and Mexico, produce rosettes of cylindrical or sub-cylindrical, very succulent leaves.

Obviously, all the forms of succulent desert plants to be seen in the Garden collection cannot be considered here, and what has been said is intended merely to give some idea of this unique and interesting group of plants, and to indicate some of the adjustments which have enabled these plants to maintain themselves successfully in the desert regions.

GERANIUMS

Few garden plants have been longer or more generally in use than the several varieties of geraniums. The parent species of Pelargonium from which most of the present-day varieties of geraniums have been derived, were introduced into England two centuries ago from South Africa, and a century ago many species were in cultivation in Europe and the work of hybridization had begun. Since that time the work of breeding has continued more or less actively and has resulted in the production of a very great number of horticultural varieties. Most of these are of the zonal or bedding

type—known generally as geraniums—and seem to have been derived, according to Bailey, from the parents *Pelargonium zonale* and *P. inquinans.* Work in hybridization has, however, been carried on with other species of Pelargonium and has resulted in the several varieties of ivy-leaved geraniums, show, or fancy, pelargoniums, and scented-leaved, or rose, geraniums.

Despite this large assemblage of horticultural varieties, commercial growers have largely confined themselves to a few of the more commonly grown forms, and in St. Louis at the present time geranium culture is limited to a very small collection of varieties. No systematic effort has apparently been made in this locality to test out the numerous varieties of geraniums with a view toward adding new and desirable forms to the list of varieties at present known to be suitable for growing in St. Louis. The Garden, therefore, is testing out during the present summer some 367 recently-purchased varieties of geraniums. They will be carefully observed and studied as to heat and drought resistance, profusion of flowers, color, shape and size of flower clusters, character of foliage, etc. These varieties are at present growing in trial beds along the main walks in various parts of the Garden. One long bed south of the main gate contains at least one specimen of practically each of the 367 varieties at present under observation in the Garden.

It is hoped that in this large number of varieties some will prove to be valuable additions to the at present small list of available forms for planting in St. Louis. The results of the trial will be announced in the BULLETIN after the observations have extended over a sufficient length of time. Although the results of these experiments will be of particular value in St. Louis, it is hoped that they may be of service also throughout the southwest. As is well known, however, the success of a plant in one locality does not always insure its success in another, although the conditions in the two may seem, in general, very similar.

The following is a list of the varieties of geraniums at present growing in the Garden:

ROZAIN-BOUCHARLAT 1913 NOVELTIES

Henri Bourdeaux (d)

BRUANT'S 1911 NOVELTIES

Beaute Tendre (s)[1]
Kleios (s)
Revisor (s)
Simone Michel Corday (s)
Caruso (d)
Jeanne Bouet (d)

[1] d = double; s = single; s-d = semi-double.

Jeanne Girard (d)
Leon Dupont (d)
Marguerite Bastien (d)
Maxence (d
Milcendeau (d)
Engel Gros (s)
Louis Reau (s)
Colonel Darde (d)
Ernest Chebroux (d)
Euripide (s)
Jeanne Allais (s)
Jeannoit (s)
La Fulgur (s)
Marcienne (s)
Baronne de Lonqueil (d)
Baron Albert von Loo (d)
Comte F. De Rouge (d)
Docteur G. Lalanne (d)
Madame Accolas (d)
Marquise d'Abadie (d)
Marquise G. de Beaumont (d)
M. C. Poinsot (d)

LEMOINE'S 1911 NOVELTIES

Arthur Chuquet (s)
Felicien Champsaur (s)
Henri Ardel (s)
Jean Rameau (s)
Leon de Tinseau (s)
Maurice Rostand (s)
Pierre Valdagne (s)
Sacha Guitry (s)
Amyot (d)
Clement Marot (d)
Joachim du Beallay (d)
Mme. Paola Radaelli (d)
Montaigne (d)
Piron (d)
Rabelais (d)

ROZAIN-BOUCHARLAT 1911 NOVELTIES

Alcazar (s)
Villa Laurenti (s)
Colibri (s)
Aida (d)
George Chavez (s)
Baron de Montal (d)
Camelia (d)
Docteur Gorde (d)
Giuseppe Marchetti (d)
Opera (d)
Simoun (d)

BRUANT'S 1910 NOVELTIES

Farman (s)
Grand Via (s)
Jane Oryan (s)
Jean Balde (s)
Jean Lionnet (s)
Lieut. Rollin (s)
Pierre Courtois (s)
Beau-Carmin (d)
Campania (d)
G. Zille (d)
Krylor (d)
Latham (d)
Pierre Made (d)
Pierre Suhau (d)
Richeri (d)
Sophia (d)
Comte Bege (s)
Francis Eon (s)
Madame Sauge (s)
Marguerite Philippe (s)
Odol (s)
Madamoiselle de Bacalau (s)
S. de Roose (s)
Velma (s)
Annie Besant (s-d)
Couallier (s-d)
G. Rivollet (s-d)
Heliodore (s-d)
Mad. Marie Sperling (s-d)
President Luizet (s-d)
Mad. Michel Corday (s-d)
Professor Opoix (s-d)
Chastenet de Castaing (s)
Frederic Plessis (s)
Leonce Depont (s)
Marquise de Lonqueil (s)
Gil May (s-d)
Rosemie (s-d)

LEMOINE'S 1910 NOVELTIES

Arthur Bernede (s)
Daniel Riche (s)
Georges Courteline (s)
Jean Cruppi (s)
Mme. Segond-Weber (s)
Robert de Flers (s)
Caesare Lombroso (d)
D'Estournelles de Constant (d)
Auguste Bernaert (d)
Guillaume Marconi (d)
Leon Desjardins (d)
Selma Lagerloef (d)

ROZAIN-BOUCHARLAT 1910 NOVELTIES

Agra (s)
Brutus (s)
Charles Bordes (s)
Cybele (s)
Estrella (s)
Felicien Pascal (s)
Phebus (s)
Princess Mafalda (s)
Rubis (s)
Agathos (d)
Comte Carminati di Brembilla (d)
Diales (d)
Excurial (d)
Fragonard (d)
Lieutenant Chaure (d)
Mephisto (d)
Valda (d)

RECENT INTRODUCTIONS FROM VARIOUS SOURCES

Scarlet Bedder (s-d)
A. J. Pierre (s)
Algernon Swinburne (s)
Amedee Giat (s)
Arvede Barine (s)
Belcolor (s)
Diamant (s)
Docteur Carrell (s)
Cardinal Mathieu (s)
Claire Frenot (s)
Emile Boutmy (s)
Emile Hinzelin (s)
Comm. Renard (s)
Fix (s)
Frivola (s)
Gaston Boissier (s)
General Gallieni (s)
Georges Beaume (s)
Henry Moisseau (s)
Interne Bazy (s)
Jean Rostand (s)
Jules Marsan (s)
Louis Renault (s)
Louise Rozain (s)
Maurice Farman (s)
Marcellum Berthelot (s)
Maurice Thomas (s)
Melodia (s)
Mme. Leonce Duval (s)
Mme. Reynaud (s)
Prince des Asturies (s)
Nisus (s)
Rose-aimee (s)
Rosamie (s)
Secretaire Barat (s)
Sereno (s)
Suzanne Rozain (s)
Suzanne Leepre (s)
Victorien Sardou (s)
Wilbur Wright (s)
Carjan (s-d)
Jacques Daurelle (s-d)

STANDARD VARIETIES

Abbie Schafer (d)
Alphonse Ricard (d)
Anais Segalis (d)
Beaute Poitevine (d)
Berthe de Presilly (d)
Centaure (d)
Colonel Thomas (d)
Cousin Janie (d)
Dagata (d)
Double Dryden (d)
Edmond Blanc (d)
E. H. Trego (d)
Fleuve Blanc (d)
General Grant (d)
General Saussier (d)
Henriot (d)
Jean Oberle (d)
Jean Viaud (d)
Jean Violette (d)
Jules Vasseur (d)
Kind Edward (d)
La Favorite (d)
Le Cid (d)
Leon Baudrier (d)
Leopold Bouille (d)
M. A. Roseleur (d)
Mauna Loa (d)
Marquise de Castellane (d)
Marquise de Montmort (d)
Miss F. Perkins (d)
Miss Kendall (d)
Mme. Barney (d)
Mme. Buchner (d)
Mme. Canovas (d)
Mme. Charrotte (d)
Mme. F. Sarloveze (d)
Mme. Jaulin (d)
Mme. Landry (d)
Mme. Laporte Bisquit (d)
Mme. Recamier (d)
Monsieur Emile David (d)
Mrs. Annie Vincent (d)
Mrs. Lawrence (d)
Ornella (d)
Peter Henderson (d)
President Baillet (d)

S. A. Nutt (d)
Suzanne Despres (d)
Admiration (s)
Alice of Vincennes (s)
Antithese (s)
Ardens (s)
Comtesse de Hohenwart (s)
Charles Guerin (s)
Commandant Ott (s)
De Courtilloles de Angleville(s)
Emmanuel Arene (s)
Eugene Sue (s)
Feuer (s)
Gloire de Rouge (s)
Gabriel Montoya (s)
Granville (s)
Jacquerie (s)
Juste Oliver (s)
L'Aube (s)
Lord Curzon (s)
Maxime Kovalevski (s)
Mlle. Anastasie Lacadre (s)
Mme. Mosnay (s)
Mrs. E. G. Hill (s)
Mrs. E. Rawson (s)
Nuit Poitevine (s)
Pamela (s)
Raymond Poincare (s)
Rival (s)
Paul Crampel (s)
Princess Alex (s)
Rosalda (s)
Snowdrop (s)
Sycamore (s)
Teodor de Wyzewa (s)
Telegraph (s)
The Sirdar (s)
Victor Grosset (s)

IVY-LEAVED VARIETIES

Achievement (s-d)
Alliance (s-d)
Ballade (s-d)
Bettina (s-d)
Caesar Franck
Corden's Glory
Colonel Baden Powell (s-d)
Corinthienne
Dina Scalarandis (d)
Hector Gaicomelle (s-d)
Incomparable
Joseph Warren (s-d)
Mme. Thibaut
Mrs. Banks (s-d)
Mrs. Hawley (s-d)
Pierre Crozy (s-d)
Rycroft's Surprise

VARIEGATED FOLIAGE VARIETIES

Mountain of Snow (s)
Mrs. Pollock
Mme. Salleroi
Silver-Leaf S. A. Nutt
Sophie Dumaresque

SCENTED-LEAVED VARIETIES

Apple
Balm
Capitatum (rose scented)
Dale Park Beauty
Fair Ellen
Lady Mary
Lady Plymouth
Lemon (lemon scented)
Mrs. Kingsbury
Nutmeg
Quercifolium
Rose
Scarlet Unique

CACTUS-FLOWERING VARIETIES

Exquisite
J. R. Greenhill
Rose Queen
Salmon Queen
The Countess
Diabolo

OTHER VARIETIES NOT CLASSIFIED IN THE ABOVE LIST

Admiral Jones
Atlantis
Abel Faivre
Bohemos
Benjamin Rabier
Belfort
Blancaflour
Comm. Fesch.
C. Bessonnet
Curiosa
Clarus
Convoitise
Comtesse de Harcourt
Double White
Doctor Danjou
Doctor Philippe Tissie

Duke of Edinburgh
Ernest Herbert
Elsa
Exposition de Lyons
Eugene Carriere
Electre
Ernest Vernet
Fiat
Gettysburg
Heteranthe
Hourlier Lenglet
Henry Dreer
Jean Tharaud
Joseph Vianney
Jules Cambon
Jean Veber
Jeanre Gazin
Leon Riotox
Lya Berger
Luigi Grandi
Lucis
Louis Mazieux
Mad. Dux
Missie Schmerber
Mme. Favart
Marie Sebille
Major Rinson
Madonna
Michele Savry
Oudjda
Odeon
Pres. Neumann
Pelargonium peltatum
Rosafiera
Reve d Ossian
Rene Bazin
Smith Seedling
Scevola
Terre Lorraine
Theodore Botrel
Virgile Rossel
Henriette Cordelet
Pierre Carmin
Jeanne Gurard
Dr. G. Labaume
Forest Park Beauty
Mme. Cheveliere
Presily
Andre Allar
Albin Valabreque
Sartos Dumont
Duchesse de Chailles

THE GOOSE OR PELICAN PLANT

Several specimens of the interesting Guatemalan goose or pelican plant *(Aristolochia Gigas* var. *Sturtevantii)* are at present in flower in the Nepenthes house. The plant owes its name to the striking resemblance which the flower bears to a pelican or to some other large bird with curved neck and head reposing on the breast. The resemblance to a pelican is heightened by the pouch-like enlargement of the upper part of the corolla—the part which corresponds to the head of the bird. Reference to the accompanying plate will serve to illustrate what has been said and it need scarcely be pointed out that the resemblance can be better appreciated if the plate is turned so that the longer axis of the flower becomes horizontal. The flower is further of interest because of its enormous size. Specimens in the Garden not infrequently measure three feet in length, this measurement, of course, including the long tail-like appendage of the corolla. Growing in its native habitat the plant is said to produce flowers of considerably larger size.

As the flower opens much of the resemblance to a bird is lost. The corolla separates along the median line of the "breast" and the sides fall back, exposing the large interior of the "body" and the dark purple opening leading into

FLOWER OF THE GOOSE OR PELICAN PLANT

the "neck." The open flower has a very disagreeable, and to some even a nauseating, odor which serves to attract a variety of insects. The latter enter the neck of the corolla and proceed down the pathway of inward-pointing hairs until reaching the bend of the neck. The hairs prevent a return and, moreover, the insects are attracted by the light which enters through six translucent areas at the top of the "head" or "bill." The stamens and stigmas are situated in close proximity to these "windows," and in attempting an escape the insects incidentally effect pollination. As many as fifty dead flies have been counted in the interior of a single flower grown in the Garden.

The goose or pelican plant is a perennial climbing species closely related to the Dutchman's pipe *(Aristolochia Sipho)*, a native of Missouri which is frequently used as an arbor plant. Plants may be kept for a number of years, provided a suitable resting period is given them during the latter part of the year. In January they should be potted in rich soil, and as soon as rapid growth begins, liquid organic fertilizer should be applied. When an abundance of flowers is desired, however, it is best to use young plants. Cuttings may be made during September from both hard and soft wood, and should be placed in sand in the propagating case, with an approximate bottom temperature of 80°F. Within three or four weeks the cuttings are usually sufficiently rooted to be potted in a light sandy soil. After a few weeks they are ready to be planted in twelve-inch boxes or pots, which will be convenient to carry the plants through to the flowering period. The growing medium should be a rich loam, composed of sand, leaf mold, and organic fertilizer in proper proportion. The plants are heavy feeders and when established should be supplied with liquid organic fertilizer. The specimens at present flowering in the Nepenthes house were grown from cuttings made last September.

NOTES

Sixty-two members of the Associated Advertising Clubs of Texas were conducted through the Garden by Mr. Pring on June 16.

Professor Weller and Mr. H. P. Chaney, both of the Department of Geology, University of Chicago, visited the Garden June 17.

Dr. Hermann von Schrenk, Pathologist to the Garden, delivered an address before the National Lumber Manufacturers' Association in Chicago, May 4, on "The Proper Uses of Lumber."

The so-called red sunflowers are at present in bloom south of the new conservatory. An extended account of these unique plants was given in the July, 1913, number of the BULLETIN.

The collection of plants of the Cattley orchid *Cattleya Mossiae* are in full bloom, one specimen bearing sixteen flowers. The flowers are very fragrant, especially in the early morning.

Members and friends of the St. Louis Branch of the American Pharmaceutical Association visited the Garden on June 12 and were personally conducted by Mr. Thompson, Assistant Botanist to the Garden.

Dr. B. M. Duggar, Physiologist to the Garden, delivered the alumni address at the commencement of the Mississippi Arts and Mechanical College, on June 1. The subject of Dr. Duggar's address was "Influence of Science."

Dr. George T. Moore, Director of the Garden, will spend a part of the summer at the Marine Biological Laboratory, Woods Hole, Massachusetts. Dr. Moore has for years been director of the botanical work in this institution, and in addition will personally conduct a portion of the course on the Morphology and Taxonomy of the Algae.

During the present summer, Dr. B. M. Duggar, Physiologist to the Garden, will, as during the past few years, conduct the course in Physiology and Ecology of Marine, Strand, and Bog Vegetation, at the Marine Biological Laboratory, Woods Hole, Massachusetts. In addition, Dr. Duggar will carry on and direct a certain amount of research work.

During the coming year an investigation will be undertaken at the Garden dealing with the problem of the relationship between resin in various kinds of pines and the growth and development of various wood-destroying fungi. While it has been known for a good many years that resin plays an important part in the life history of pine trees and other conifers, practically nothing is known as yet concerning the relationship which exists between the various resins and the different species of fungi which grow both in living pine trees and on pine timbers. In view of the fact that this problem is exceedingly important in connection with the proper use of yellow pine lumber, the Yellow Pine Manufacturers' Association will coöperate actively with the Garden during the coming academic year in an investigation of this problem. Mr. Sanford M. Zeller, M.A., from the University of Washington, who will be enrolled as a graduate student at the Garden next fall, will devote a large part of his time to this work.

The Rufus J. Lackland Research Fellowships in Botany for the academic year 1914-15 have been awarded to the following:

Mr. A. R. Davis, A.B. Pomona College, 1912, reappointed.

Mr. L. O. Overholts, A.B. Miami University, 1912, reappointed.

Mr. Joseph C. Gilman, B.S. University of Wisconsin, 1912. Since graduating Mr. Gilman has been in graduate work in plant pathology at the same institution.

Mr. Goodwin L. Foster, A.B. Dartmouth College, 1913. During the past year Mr. Foster has held the position of Teaching Fellow in the Henry Shaw School of Botany of Washington University.

Mr. Richard A. Studhalter, A.B. University of Texas, 1912. Since graduating, Mr. Studhalter has been Assistant in Botany, at the Kansas State Agricultural College, and later Agent, in the Office of Investigations in Forest Pathology, Bureau of Plant Industry, U. S. Department of Agriculture. Mr. Studhalter is author and joint author of a number of publications dealing with the dissemination of the chestnut-blight fungus.

STATISTICAL INFORMATION FOR MAY, 1914

GARDEN ATTENDANCE:

Total number of visitors 15,087

PLANT ACCESSIONS:

Total number of plants received in exchange 4
Total number of packets of seeds received in exchange 2

PLANT DISTRIBUTION:

By gift 59

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought 21
Total number of books and pamphlets donated 249

HERBARIUM ACCESSIONS:

By Purchase —

Mrs. Helen D. Macoun—Plants of Canada 177
L. O. Overholts—Plants of Colorado 118

By Gift —

J. A. Drushel—Plants of Alabama and Ohio 15
Mrs. J. V. Leigh—*Aquilegia caerulea* James from Colorado. 1
E. J. Palmer—*Geolobium minimum* Mack. from Missouri ... 1
Miss Norma E. Pfeiffer—*Salix cordata* Muhl. from North Dakota 1
H. von Schrenk—Southern pines 24
H. von Schrenk—*Populus grandidentata* Michx. from Arkansas 12
Mrs. R. J. Terry — *Rhododendron nudiflorum* (L.) Torr. from Missouri 1

By Exchange —

U. S. National Museum — Plants from Texas and New Mexico 120

TOTAL 470

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Beginning with the first Sunday in April and continuing until November 30, the Garden will be open Sundays from 2 P. M. until sunset. Admission free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to November 1, starting from the main gate at 3 o'clock. Other trips may be arranged for by special appointment.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

The Garden will be closed all day July 4.

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Assistant to the Director,

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BENJAMIN M. DUGGAR,
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Mycologist and Librarian.

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Assistant Botanist.

JESSE M. GREENMAN,
Curator of the Herbarium.

MELVIN C. MERRILL,
Research Assistant.

JAMES GURNEY,
Head Gardener, *Emeritus.*

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Engineer.

C. R. FOLLEN,
Construction.

G. H. PRING,
Orchids and other Exotics.

P. FOERSTER,
Farm and Stables.

M. SCHILLER,
New Conservatories.

C. W. GARRETT,
Outside Floral Displays.

K. N. SVETLIKOFF,
Plant Breeding and Seeds.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. II JULY, 1914 No. 7

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ST. LOUIS, MO.
1914

PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:

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OF THE MISSOURI BOTANICAL GARDEN

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Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., July, 1914 No. 7

AMERICAN GINSENG

Numerous inquiries have been made at the Garden concerning the cultivation and value of the American ginseng *(Panax quinquefolium)*, the root of which, according to certain lurid advertisements, is supposed to be "worth its weight in precious stones." This plant grows wild in eastern Canada and in all of the states east of the Mississippi with the exception of those bordering on the Gulf of Mexico. It has also been found in Missouri, Arkansas, and Iowa, but usually does not occur abundantly west of the Mississippi. Missionaries searching for a plant similar to the Chinese ginseng *(Panax Ginseng)* found the American species in 1716, and there soon sprang up a considerable export trade, which at the present time, including both wild and cultivated roots, exceeds a million dollars annually.

Continuous collecting of the wild ginseng for nearly two centuries has gradually depleted the supply, particularly since the plants are frequently dug before the seeds mature, and consequently the natural replacing of the crop which should occur is prevented. It seems probable, therefore, that a reasonable profit might be expected from the cultivation of ginseng provided the conditions are favorable and one takes into consideration the length of time required for maturing the roots. Only under especially favorable conditions, however, with ability to prevent the ravages of certain serious diseases, is there much likelihood of ginseng being more profitable than many other crops which might be grown. It has been estimated that seven hundred acres in cultivation in America would be ample to supply the present demand from this country, and there is some danger from over-production should a large number of people successfully engage in growing this plant. In any case, no one should attempt raising ginseng for profit without being thoroughly conversant with the difficulties attending its cultivation, and the conditions of the market.

The American ginseng, which is closely related to the

members of the carrot family, grows naturally in rich, damp soils, such as are usually found in forests, and may be associated with other closely related plants which the casual observer would mistake for true ginseng. The first season it is small and inconspicuous, being about two inches high and possessing not over four leaves. The second year there is produced a single stem, at the top of which are found one or more compound leaves, made up of from three to ten leaflets. By the time the plant is five or six years old it will have formed three or four leafstalks, each bearing several leaflets.

The only part of the ginseng which is commercially valuable is the root, together with a small inconspicuous underground stem. The latter bears scars from the previous annual leafstalks and by counting these the age of the plant can be approximated. Although a single ginseng has been known to persist from fifty to sixty years, the value of the roots usually decreases after the eighth or tenth year and it is customary therefore to dig them when from five to seven years old.

Practically the only market for ginseng is in China and Korea. Here the plant is highly prized for its supposed medicinal value and the sometimes startling resemblance of the root to the trunk and limbs of a man (the Chinese name literally means "man-wort") has probably been partly responsible for the superstitious awe with which the virtues of ginseng are regarded. Not that a belief in the relation of the outward form of a plant and its effect upon man is by any means confined to the Chinese, however. The common names of many plants, such as "liver-wort", "lung-wort", etc., are remnants of the old so-called "doctrine of signatures" which was exploited to its highest degree by the Swiss alchemist Bombastus Paracelsus, in the latter part of the sixteenth century. This doctrine flourished for centuries and even to-day remnants of it survive. In spite of the skepticism which prevails regarding the value of ginseng as a drug, there seems to be some reason for believing that it has a distinct effect upon the Chinese and that its use is justified upon other grounds than mere superstition. Wilson, in "A Naturalist in Western China," says: "The famous drug, ginseng, comes from Korea and Manchuria and the best quality sells for its weight in gold. To the Chinese this drug is the *radix vitae,* restoring strength, vitality, and power to old and young. So precious is the 'life-giving root' that the best plants are, in theory, reserved entirely for the emperor's use. On the Chinese system this drug unquestionably acts

as a strong restorative, tonic, and aphrodisiac, adverse Western opinion notwithstanding."

In Korea ginseng growing is a government monopoly and in the past formed one of the chief sources of revenue. A few years ago the business had greatly declined, due to various parasitic diseases affecting the plant, and to the lack of proper governmental control. Recently experts have been engaged to study the diseases and much needed reforms have been introduced into the administration of the industry, so that it is probable that within a few years the monopoly will be as profitable as formerly. What effect this will have upon the American market for ginseng remains to be seen.

Some of the regulations for the enforcement of the ginseng monopoly, which likewise afford an idea of the importance of this industry in Korea, are as follows:

"The cultivation of ginseng is not allowed except by those licensed by the government."

"Separate certificates from the Minister of Finance must be obtained for permission to sow, transplant, or harvest ginseng."

"Persons coming under any of the following categories shall not be allowed to engage in the cultivation of ginseng:

(a) Persons contravening laws, regulations, and orders concerning ginseng.

(b) Persons showing unfavorable results in the cultivation of ginseng.

(c) Persons intending to engage in the cultivation of ginseng in localities considered to be inconvenient for the control of the business.

(d) Persons whose ginseng fields do not exceed fifty Kan in area."

The minister of Finance appoints the date and place for the delivery of raw roots to the Government, furnishes information and regulates the management of ginseng fields, the number of roots to be planted, the space to be left between roots, the method of preventing and stamping out diseases and destruction of injurious insects, the method of packing and transporting raw roots, and many other details too numerous to mention.

The right of manufacturing so-called "red-ginseng" is exclusively retained by the government, and formerly its exportation was prohibited. While the method of preparing red ginseng varies somewhat, it consists essentially of a steaming,

drying, and moistening process which causes the root to assume a cherry red color and a hard, glassy consistency. Sugar may or may not be added.

All of the roots from certain districts in Korea are manufactured into "white ginseng." Formerly when the product was of higher quality two kinds of "white" were produced, the "straight" and "bend." Now, however, practically all of the raw material is made into "bend." The best season for gathering the roots is about the last week in August, but if there is danger from disease the crop may be dug a month earlier. Early in the morning is supposed to be the most favorable time for removing the roots from the ground. They are immediately washed, then the outer skin peeled off with a piece of bamboo, after which they are polished with hemp cloth and dried for a day in a shady place. By this process the branch roots become soft enough to be bent into the form of a man sitting with his knees against his stomach and they are bound in this position by means of a piece of tough grass or reed. Finally, the roots are dried in a sunny place, where the wind is not too strong, and packed ready for shipment.

The collection of ginseng in the Garden will be found to the east of the herbaceous tract in the lath shed, constructed over the plants to provide the necessary shade. The plants are three years old and consequently not ready to harvest, but a good idea may be obtained of the appearance of the wild ginseng by those who wish to be able to recognize this form growing in the woods.

A GIANT CACTUS

There has just been received from Tucson, Arizona, a specimen of a giant cactus *Carnegia gigantea (Cereus giganteus)* which marks a noteworthy addition to the collection of succulent desert plants in the Garden. As will be seen from the accompanying plate, the plant consists essentially of a leafless columnar trunk provided with a regular succession of vertical furrows and ridges, the latter each bearing a row of stout spines. In the desert the older plants usually produce branches which come out from the main trunk at first at right angles and then curve upward and grow parallel with the parent stem, giving the plant the appearance of a giant candelabrum. It was not attempted to ship such a plant to the Garden owing to the danger of breaking off the branches in transit. It is hoped, however, that the specimen received will ultimately branch and give a complete idea of this striking southwestern-desert form.

CARNEGIA GIGANTEA (CEREUS GIGANTEUS)

The plant, which measures about eleven feet in height and twenty-one inches in diameter at the thickest place and weighs over a thousand pounds, has been placed in the center of the yucca dome. It came well crated and packed in branches of the desert creosote bush and sustained little or no injury in the journey.

A FRUITING DATE PALM

A recent acquisition of unusual interest is a fruiting specimen of date palm *(Phoenix dactylifera)*. Owing to various causes date palms do not ordinarily produce fruit in the greenhouse and it is only when plants already bearing fruit are secured from date-producing regions that an adequate idea of this important food-yielding plant may be had here. In order to give visitors to the Garden such an opportunity, a small date palm, bearing a cluster of over one hundred and fifty green but almost full grown fruits, was secured from Yuma, Arizona, and has been placed along the west wall of the palm house directly opposite the front entrance.

The date ordinarily is associated with Arabia, Mesopotamia, and northern Africa, and while it is true that these are at present the only commercially important date-producing regions, it must not be supposed that date culture is confined to these localities. India and Mexico too yield dates, though of a poor quality owing to a lack of proper cultural methods, and the industry furthermore is gradually and apparently permanently establishing itself in the United States.

The date palm thrives in a great variety of soils but is unique in that it requires an abundance of water at the roots, but a hot, dry atmosphere for good fruit production. The dry, hot atmosphere is obviously obtainable in most cases only in arid or semi-arid regions and under those conditions the necessary supply of water can usually be furnished only by some system of irrigation. In the date-producing sections of the Old World many types of irrigation — some of them extremely crude — are employed, though in some cases a natural high water level or a periodic inundation supplies the requisite amount of water to the roots. In the United States the hot and dry portions of southern California and Arizona are adapted to date culture where recently the necessary water has become available through irrigation. Date palms, i. e., the "off-shoots," or "suckers," of date palms, have been introduced from various date-growing regions of the Old World; the experiments in many cases

have met with marked success and the area devoted to date culture—situated principally in the Salton Basin of Southern California—has gradually increased. While the industry has not as yet assumed very great proportions there is every reason to believe that it will as time goes on, especially when varieties, either introduced or locally developed, are obtained which are particularly suited to the conditions in the arid southwest.

NOTES

Dr. L. R. Jones, Professor of Plant Pathology in Wisconsin University, visited the Garden July 22.

Dr. L. H. Harvey, Professor of Biology at the State Normal School, Kalamazoo, Michigan, spent July 14 at the Garden.

Mr. G. H. Bretnall, Professor of Biology at the State Normal School, La Crosse, Wisconsin, visited the Garden on July 21.

A party of 50 real estate men, mostly from Kansas City, were conducted through the Garden by Mr. Thompson, Assistant Botanist to the Garden, on July 6.

One of the most striking outdoor floral displays in the Garden at the present time is that of the American lotus *(Nelumbium luteum)*, a large number of plants of which are flowering in the small pool in the North American tract, directly west of the new director's residence.

Professors A. H. Hall and E. B. Babcock, both of the University of California, visited the Garden late in June. Professor Hall spent considerable time consulting certain sections of the herbarium, and Professor Babcock examined some of the work being done in the Garden in plant breeding.

More visitors to the Garden are availing themselves of the Saturday personally conducted trips. The party which was conducted through the Garden on July 18 numbered thirty and showed much interest in the rice, cotton, and sugar plantations, as well as in the newly acquired giant cactus and date palm.

About a thousand plants of the button snakeroot *(Liatris spicata)* are at present in flower along the edge of one of the knolls in the southwestern part of the main garden. This plant, with its long showy spikes of lavender-rose flowers, grows wild in Missouri, the specimens at present flowering in the Garden having been obtained from a railroad embankment near Montgomery City, Missouri.

THE FRUITING DATE PALM

Geh. Regierungsrat Dr. O. Appel, of the Kaiserlichen Biologischen Anstalt für Land-und Forstwirtschaft in Berlin-Dahlem, who is giving a course of lectures at the Graduate School of Agriculture, at present in session at Missouri University, and who will subsequently make a three months' tour of the United States in a study of potato diseases, visited the Garden on July 25 in company with Mr. W. A. Orton, Pathologist in Charge cotton and truck diseases and sugar plant investigations, U. S. Department of Agriculture, Bureau of Plant Industry.

Volume 1, number 2 of the Annals of the Missouri Botanical Garden has appeared with the following contents:

"A Trunk Disease of the Lilac." Hermann von Schrenk, *Pathologist to the Garden.*

"Two Trunk Diseases of the Mesquite." Hermann von Schrenk, *Pathologist to the Garden.*

"The Thelephoraceae of North America. I." Edward A. Burt, *Mycologist and Librarian to the Garden.*

"A Contribution to our Knowledge of the Relation of Certain Species of Grass-Green Algae to Elementary Nitrogen." Jacob R. Schramm, *Assistant to the Director.*

"The Effect of Certain Conditions Upon the Acidity of Tomato Fruits." B. M. Duggar, *Physiologist to the Garden,* and M. C. Merrill, *Research Assistant to the Garden.*

"A Method for the Differential Staining of Fungous and Host Cells." R. E. Vaughan, *Exchange Fellow in the Henry Shaw School of Botany of Washington University.*

"Indications Regarding the Source of Combined Nitrogen for *Ulva Lactuca.*" G. L. Foster, *Teaching Fellow in the Henry Shaw School of Botany of Washington University.*

STATISTICAL INFORMATION FOR JUNE, 1914

GARDEN ATTENDANCE:

Total number of visitors	12,315

PLANT ACCESSIONS:

Total number of plants received in exchange	90
Total number of packets of seeds received in exchange	11

PLANT DISTRIBUTION:

In exchange	16
By gift	503

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	25
Total number of books and pamphlets donated	217

HERBARIUM ACCESSIONS:

By Purchase—

T. S. Brandegee—Plants of Mexico, collected in 1913 by C. A. Purpus	485
W. E. Broadway—Plants of Tobago, W. I.	50
B. F. Bush—Plants of Missouri	98
R. Friedländer & Sohn—K. W. Krieger's "Fungi Saxonici exsiccati," Fasc. 46, Nos. 2251-2300	50
O. Leonhardt—Miscellaneous fungi	326
T. O. Weigel—Plants of Kamerun, collected by G. Zenker, Cent. V, Nos. 400-449	50

By Gift—

H. W. Anderson—*Peronospora parasitica* on *Arabis laevigata* from Indiana	1
J. B. Baker—*Sabbatia campestris* Nutt. from Texas	1
H. B. Brown—Wood-destroying fungus	1
G. M. Darrow—Fungus parasitic on blackberry roots	1
Miss Elizabeth Green—Plants from Massachusetts, New York, and Missouri	11
E. L. Johnston—Plants of Colorado	103
S. O. Matthews—Plants of Texas	31
H. von Schrenk—Wood-destroying fungi	5
F. Shreve—Plants of Arizona	3

By Exchange—

New York State Museum—Specimens of fungi, including portions of types, etc.	134
University of California—*Senecio* from California and Nevada	2
E. M. Wakefield—Specimens of fungi	7

By Field Work—

Rev. John Davis—Plants of Missouri	393
Total	1,752

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Personally conducted trip through Garden every Saturday afternoon from May 1 to November 1, starting from the main gate at 3 o'clock. Other trips may be arranged for by special appointment.

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MISSOURI BOTANICAL GARDEN BULLETIN

Vol. II AUGUST, 1914 No. 8

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ST. LOUIS, MO.
1914

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FRUITING PINEAPPLE IN BROMELIAD HOUSE

Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., August, 1914 No. 8

COLLECTION OF BROMELIADS

The Garden collection of bromeliads includes about 450 species which, although they vary considerably in growth and appearance, are chiefly short-stemmed plants with rigid spiny leaves and showy flowers. They are for the most part native of the American continent and adjacent islands. In nature, the majority of these plants grow epiphytically upon trunks or branches of trees, a habit which is well illustrated in the northwest corner of the bromeliad house, where a small tree trunk is bearing several specimens. Other members of the family are planted in pots or baskets containing equal parts of peat and fern roots. An abundance of moisture is an important factor in the successful raising of these plants, many of which are of economic value, both for the fibre and edible fruits produced. Perhaps the most important of those used for fruits is the pineapple *(Ananas sativus)*. From the center of the rosette of long, strap-shaped leaves is produced the flower spike which terminates in the whorl of small bluish flowers. The thickened head, after the flowers are fertilized, finally develops into the well-known fruit. The accompanying plate, from a photograph of a pineapple in the bromeliad house, shows well the way in which the pineapple fruit originates.

Near this fruiting specimen in the same house, is a variegated pineapple which is of interest because of its value as an ornamental foliage plant. The cultivation of the pineapple for commercial purposes has extended of late years to the West Indies, tropical America, the Azores, and even Australia, and canned pineapple are now exported in large quantities from Singapore, the Bahamas, Fiji, and Natal. Aside from those grown in Florida, practically all the pineapples produced in this country are raised in greenhouses and because of the superiority of the fruit when allowed to ripen on the plant, as compared with those picked for shipping, the possibility of establishing a paying industry in the growing of pineapples under glass is very good. For such purposes a low built house should be

selected, with beds built close to the heating pipes in order to provide bottom heat. These beds are filled with tan bark, or similar moisture containing material, into which the plants are plunged. It is necessary to maintain a moist atmosphere in such a house, with a temperature of about 90°. Plants subjected to such treatment may be expected to yield fruit in about three years.

One of the best-known bromeliads is *Tillandsia usneoides,* the so-called "Spanish moss," or "old man's beard." This is quite common in the Southern States, where it is found hanging in long festoons from the trees upon which it grows. Numerous companies are organized throughout the South for collecting and preparing Spanish moss, to be used for filling mattresses, cushions, etc. While the plant may be used as collected, it usually is subjected to a fermenting process which removes the outer cellular portion, and after being dried it becomes stiff and wiry. A closely related plant is *Tillandsia Caput-Medusae,* a native of the West Indies, which because of the twisted leaves arising from the swollen base, gives to it the common name of "Medusa's head," or "octopus plant."

The giant of the tillandsias is *Tillandsia grandis,* which produces huge rosettes of large strap-shaped leaves about five feet long. The flowering spike may attain a height of ten or twelve feet, resembling a century plant. Tillandsias of the "splendens" and "Lindeni" type bear unusually showy flowers and some interesting hybrids derived from these types are in cultivation at the Garden.

Good flowering species of the genus Billbergia are represented in the Garden collection and the heads of numerous bright red flowers — occasionally tipped with purple — together with the large red bracts, are very showy. *Billbergia speciosa,* one of the oldest species under cultivation, produces a pendant flowering spike bearing pale cream or white tubular flowers which are not infrequently tipped with blue. These, with the long rose-colored bracts, produce a combination which invariably attracts attention.

Some other noteworthy specimens in the Garden collection are *Aechmea robusta,* an ornamental plant, somewhat resembling the pineapple; the various species of Karatas, frequently used, because of their beautifully colored leaves, as decorative foliage plants; and the various species of Cyptanthus, the most noteworthy being *Cyptanthus zonatus,* which differs from the other bromeliads in being procumbent in its habit. The leaves are undulated and reddish brown, bridged with white glaucous bands. Other species are striped

with red and various shades of green. Representative plants of the genera *Pitcairnia, Guzmania, Catopsis, Nidularium,* etc., are to be found in the bromeliad house and are well worthy of study and observation because of the peculiarity of the markings of the leaves or the interesting flowers.

PERSONALLY CONDUCTED TRIPS.

Although many have already availed themselves of the opportunity to be personally conducted through the Garden on Saturday afternoon, it is believed that more would do so if they understood the advantage to be derived from this tour through the houses and grounds. The object in providing these trips is to enable the visiting public to become more closely acquainted with the Garden, including its history and present work, but more particularly the plants and collections which are worthy of special attention. While it is true that a visit to the Garden, even without a guide, is well worth while, many of the most interesting things may be overlooked and the information derived from the guide will certainly enable the visitor to carry away a more accurate knowledge of the Garden and what it stands for, thus aiding in carrying out the present plan of making it a place of public instruction as well as of pleasure. The personally conducted trip is in the nature of a popular lecture, dealing with the Garden in general and the plants on exhibition in particular. The aim is to give reliable statements about the various collections and to answer, in so far as possible, the numerous questions which are constantly being raised by the visitor. At this season of the year, the trip which starts from the main gate at three o'clock on every Saturday afternoon, begins with the lily pond, where the various types of water lilies are pointed out and the origin of each indicated. Entering the new greenhouses, some of the more important palms, particularly those of economic value, are first viewed. The rattan palm, much used in the manufacture of furniture, the plant furnishing the palm leaf fan, as well as the fish-scale palm, and the date palm now in fruit, are all to be found here. Much resembling a palm, though belonging to a different family, is the plant from which Panama hats are made, a good specimen of which is on exhibition. Next, in the house devoted to economic plants, may be seen many of the tropical fruit trees, few of which the visitor has ever seen growing, including the orange, olive, guava, Japanese plum, mangosteen, and numerous other similar fruits. Here are also oil and resin-producing plants, together with some of the species of rubber, as well as the tree which furnishes the

foundation for most of the chewing gums. In the group of textile fibre plants, are found those from which are made Manila rope and paper, New Zealand hemp, sisal hemp, "silk floss," and other important economic products. The patchouli plant, different species of jasmine, and the fragrant olive, are in the section devoted to perfume plants, and the coffee, black pepper, allspice, cinnamon, ginger and nutmeg may also be seen growing in this house.

Close by is the so-called "St. John's bread," which yields an edible pod of the bean type which is supposed to be the "locust" upon which John the Baptist subsisted while in the wilderness, as well as the "husks" which constituted the food of the prodigal son. A good collection of medicinal plants is also to be seen here.

In the fern house the peculiar way in which the staghorn fern has survived, because of its drought-resisting qualities, is explained and in the collection of desert plants much information concerning their economic value and interesting manner of growth is given. Why, for instance, have the cacti, native of America, and the euphorbias, native of Africa, which are in no way closely related, assumed the same characteristic habits of growth? The giant cactus of Arizona, as well as the spineless cactus, the so-called "living rock," the "dumpling," and the "organ pipe" cactus are all pointed out and discussed. In the same house are the interesting odd-shaped blossoms of the parachute flower, apt to be passed by without notice by the casual visitor.

Continuing through this range of greenhouses the remarkably fine specimen of vanilla orchid is observed, together with some of its beans which furnish our most-used flavoring extract. Next come the carnivorous plants, including the pitcher plants, Venus' fly traps, and the sun dews, the peculiar adaptation of these for catching and devouring insects being fully explained by the guide.

At the present time perhaps the most noteworthy collection of outdoor plants is to be found in the herbaceous tract. Here are gathered together a number of our common economic plants, together with some others which are not usually grown in this vicinity. While the products are familiar to all, yet the growing plants are new to many visitors. Among the foodstuffs grown here are rice, oats, various kinds of corn, rye, buckwheat, sugar cane, sorghum, sugar beets, and peanuts. Few people realize that peanuts grow upon small annual plants and that while the flowers are borne above ground the nuts develop under the earth in much the same manner as potatoes. An excellent field

of cotton, one of tobacco, flax, and the plant from which the straw of brooms is produced, are found in this tract. Here, likewise, are the various grains, cowpeas, alfalfa and other important sources of stock food. The collection of hardy drug plants, which are of special interest to students of medicine and pharmacy, is also visited.

Incidentally throughout the trip, many points of interest concerning the origin of the Garden, its organization, its management, and the uses of the various buildings are given. The trips usually last from one and one-half to two hours, and in no way can one obtain in so short a time such a comprehensive idea of the Garden and its activities.

THE TWENTY-FIFTH ANNIVERSARY

On October 15th and 16th will be celebrated the twenty-fifth anniversary of the organization of the Board of Trustees of the Missouri Botanical Garden under the will of Mr. Shaw. This event, which actually took place on September 10, 1889, marked the origin of the Missouri Botanical Garden as a botanical institution, public in character, and the Board of Trustees decided early in the year that it should be fittingly observed. A number of foreign delegates have been invited and there will be a large attendance of American botanists and scientists. While it is feared that the present European disturbance may prevent the coming of some of those from abroad who had promised to be present and read papers, it is hoped that a few at least may be here, and if the mails are not entirely cut off the papers of those unable to come will be read.

In addition to carrying out, in so far as may be possible, the formal program printed below, there will be special floral displays both indoors and out. The old museum building, which has been closed for years, is being renovated and will contain a general exhibit of plants producing disease, showing the effect of these parasites upon other plants as well as upon various woods and timbers. Part of the old residence of Mr. Shaw will be devoted to housing a historical collection consisting of various portraits and articles relating to the founder of the Garden, as well as autograph letters, books, etc., of special interest to the visiting botanists.

THURSDAY, OCTOBER 15.

10:30 A. M. Automobile ride through the city for delegates and visiting scientists. Automobiles will leave the Jefferson Hotel (corner of Twelfth and

Locust) at 10:30 sharp, arriving at the Garden at about 1:00 o'clock.

1:00 P. M. Lunch at the Garden.

2:00 P. M. Graduate Lecture Room.

Address of Welcome - - Director George T. Moore

"THE HISTORY AND FUNCTIONS OF BOTANICAL GARDENS"

Assistant Director Arthur W. Hill
Royal Botanic Gardens, Kew, England

"THE PHYLOGENETIC TAXONOMY OF THE FLOWERING PLANTS"

Professor Charles E. Bessey
University of Nebraska, Lincoln, Nebraska

"DEVELOPMENT OF THE NORWEGIAN FLORA SINCE THE ICE AGE"

Professor N. Wille
University of Christiania, Christiania, Norway

"THE VEGETATION OF MONA ISLAND"

Director in Chief N. L. Britton
New York Botanical Garden, Bronx Park, N. Y.

"THE SCIENTIFIC SIGNIFICANCE OF THE IMPERIAL BOTANIC GARDEN OF PETER THE GREAT, WITH SPECIAL REFERENCE TO THE FLORA OF ASIA"

Dr. Wladimir I. Lipsky
Jardin Impérial Botanique de Pierre le Grand, St. Petersburg, Russia

"COMPARATIVE CARPOLOGY OF CRUCIFERAE WITH VESICULAR FRUITS — SOME GENERAL BIOLOGICAL AND SYSTEMATIC CONCLUSIONS"

Director J. Briquet
Conservatoire et du Jardin Botaniques de la Ville Geneve, Geneva, Switzerland

"THE ORIGIN OF MONOCOTYLEDONY"

Professor John M. Coulter
University of Chicago, Chicago, Illinois

8:30—11:30 P. M. Reception. Director's Residence.

FRIDAY, OCTOBER 16

10:30 A. M. Special personally conducted trip through the conservatories and grounds of the Garden. Opportunity will be given during the morning for those who wish to spend time in the library or herbarium.

12:30 P. M. Lunch at the Garden.

1:30 P. M. Graduate Lecture Room.

"RECENT INVESTIGATIONS ON THE PROTOPLASM OF PLANT CELLS AND ITS COLLOIDAL PROPERTIES"

Professor Frederick Czapek
Physiologisches Institut der K. K. Deutschen Universität, Prag, Austria

"EXPERIMENTAL MODIFICATION OF THE GERM PLASM"

Director D. T. MacDougal
Department of Botanical Research, Carnegie Institution of Washington, Tucson, Arizona

"HORMONE IM PFLANZENREICH"

Director Hans Fitting
Botanisches Anstalten der Universität Bonn, Bonn, Germany

"THE LAW OF TEMPERATURE CONNECTED WITH THE DISTRIBUTION OF MARINE ALGAE"

Professor William A. Setchell
University of California, Berkeley, California

"UEBER FORMBILDUNG UND RHYTHMIK DER PFLANZEN"

Director Georg Klebs
Botanisches Institut Universität Heidelberg, Heidelberg, Germany

"PHYLOGENY AND RELATIONSHIPS IN THE ASCOMYCETES"

Professor George F. Atkinson
Cornell University, Ithaca, New York

"THE ORGANIZATION OF A MUSHROOM"

Professor A. H. Reginald Buller
University of Manitoba, Winnipeg, Canada

"A CONSPECTUS OF BACTERIAL DISEASES IN PLANTS"

Dr. Erwin F. Smith
Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

7:30 P. M. Trustees' Banquet. Liederkranz Club.

NOTES

In the herbaceous tract the rice is now heading and the cotton plants present an interesting series of transitions from the just opened flower to mature bolls.

On July 24 the wives and daughters of delegates to the Optometric Convention visited the Garden and were escorted through the houses and grounds by Mr. Pring.

Dr. Elbert Bartholomew, Instructor in Botany in the State University at Madison, Wisconsin, spent several hours,

August 1, looking over the library, herbarium, laboratories and grounds.

Dr. George V. Nash, Head Gardener of the New York Botanical Garden, with his wife and daughter, visited the Garden, July 30, on their way east from Seattle, Washington.

On August 10 the Garden was visited by Mr. Adolph Rolloff, Director of the State Botanical Garden in Tiflis, Russia. Mr. Rolloff is an honorary member of the Transcaucasian Division of the Imperial Russian Society of Floriculture.

Mr. Wenceslas Kotehetkow, Assistant Russian Government Agricultural Commissioner, and Mr. Wladimir Generasoff, Secretary of the Russian Government Agricultural Agency, were interested visitors at the Garden August 17. They were escorted by Mr. Svetlikoff, of the Garden staff.

Mr. Ernest J. Palmer spent the first two weeks of August at the Garden working over the plants obtained during the past spring and early summer in the southwest, where he has been collecting for the Arnold Arboretum and the Missouri Botanical Garden.

One of the banana plants in the old range of greenhouses is now in bloom. Those who are interested should observe this plant from time to time and notice the transition from flowers to fruits. An article on the banana will appear in an early issue of the BULLETIN.

An exceptionally fine display of pitcher plants *(Nepenthes)* is now on exhibit. The pitchers of these plants are not uncommonly mistaken, by many people, for flowers, whereas they are but modified leaf-blades. The flowers, when they do appear, are of but little decorative value and usually are cut off so as not to retard the development of the pitchers. However, for purposes of demonstration, several plants in the collection have been permitted to flower.

Attention is called to the opening on October 1st of the new courses in gardening, horticulture, landscape architecture, etc., detailed announcement of which was made in the April BULLETIN. The applications of those intending to take the examinations for the scholarships on September 1st are already on file, but those wishing to enroll as students paying tuition or to take one or more courses along special lines should attend to the matter promptly as the facilities are limited and the indications are that it may be necessary to restrict the number of those taking the first year work.

The unprecedented drought of the summer of 1914 has at last been broken and the Garden is beginning to show the effect of the recent rains. According to the meteorological summary of the Weather Bureau, "The period extending from March 1st, 1914, to July 31st, five months, was the driest of which there is a record in St. Louis. The record covers a period of 78 years, from January, 1837, to date. The total precipitation was 5.48 inches. The normal amount for this period is 20.48 inches. Previous to this year the least precipitation for the five months ending on July 31st, was 9.06 inches in 1871; the greatest precipitation for a similar period was 40.31 inches in 1848. In the months of May, June and July, 1914, the total was 2.31 inches, which is by far the lowest amount on record for a similar period; previous to this year the lowest amount was 4.24 inches in 1911; before 1911 the lowest record was 5.32 inches in 1870. May and June, 1914, were phenomenally dry, the total precipitation for these two months being .79 inch, or 8.53 inches below the normal."

STATISTICAL INFORMATION FOR JULY, 1914

GARDEN ATTENDANCE:

Total number of visitors 16,836

PLANT ACCESSIONS:

Total number of plants received in exchange 4
Total number of packets of seeds received in exchange 121

PLANT DISTRIBUTION:

Total number of plants distributed in exchange 317

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought 93
Total number of books and pamphlets donated 211

HERBARIUM ACCESSIONS:

By Purchase —

E. Bartholomew—"Fungi Columbiani," Cent. 43, Nos. 4201-4300 100

—"North American Uredinales," Cent. 11, Nos. 1001-1100 100

H. Sudre—"Batotheca Europaea," Fasc. XII, Nos. 551-600. 50

—"Herbarium Hieraciorum," Fasc. IV, Nos. 151-200. 50

Th. O. Weigel — Plants of Kamerun, collected by Dr. G. Zenker, Cent. IV, Nos. 450-499 50

By Gift —

N. O. Booth—*Solanum carolinense* L. from Oklahoma	1
J. R. Churchill—Plants of Colorado, Massachusetts, etc	79
J. A. Drushel—Plants of Missouri	6
F. W. Russe—*Pseudotsuga mucronata* Sudw	3

By Exchange —

University of Texas—Plants of Texas	232

By Field Work —

Rev. John Davis—Plants from Missouri	479
TOTAL	1,150

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Beginning with the first Sunday in April and continuing until November 30, the Garden will be open Sundays from 2 P. M. until sunset. Admission free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to November 1, starting from the main gate at 3 o'clock. Other trips may be arranged for by special appointment.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

☞ **The Garden will be closed all day, September 7, Labor Day.**

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W. F. LANGAN,
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C. R. FOLLEN,
Construction.

G. H. PRING,
Orchids and other Exotics.

P. FOERSTER,
Farm and Stables.

M. SCHILLER,
New Conservatories.

C. W. GARRETT,
Outside Floral Displays.

K. N. SVETLIKOFF,
Plant Breeding and Seeds.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. II SEPTEMBER, 1914 No. 9

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ST. LOUIS, MO.
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OF THE MISSOURI BOTANICAL GARDEN

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PALM FRUITS AND SEEDS

Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., September, 1914 No. 9

PALM FRUITS AND SEEDS

An exceedingly interesting collection of palm seeds, comprising forty-five species, has recently been received from the Botanical Garden, at Rio de Janeiro, Brazil. From these seeds it is hoped that the Garden may acquire a number of new species and new specimens of species already in the collection. The time required for the germination of palm seed varies with the species and ranges from a few weeks in such forms as the Chinese fan palm (*Livistona chinensis*) to as much as three years in some of the attaleas.

Palm fruits are extremely variable as regards size, ranging from the small cherry-like structures of the various species of the genus *Sabal* to the huge fruits of the cocoanut palm. A similar variation exists as regards the consistency of the fruits. At one extreme are fruits, like those of the date palm, with a fleshy edible covering, and at the other are fruits, exemplified by those of the cocoanut palm, which have an extremely large, dry, fibrous husk covering the seed. In the date, therefore, it is the covering of the seed which is edible whereas in the cocoanut it is the seed itself which is eaten, the fibrous covering, or husk, being used for the manufacture of cordage, mats, etc. The seed, while varying greatly in shape and size in the various species, conforms to one general type, that of a hard nut-like structure more or less filled with a firm kernel rich in oil and proteins. Notably in the cocoanut the interior of the seed is hollow, the kernel occupying only the peripheral portion.

Aside from the great importance of palms as decorative plants, both in tropical and temperate countries, these plants yield many products of great commercial value. Of these there should be mentioned, in the category of foods, dates, cocoanuts, sago (coming from the pith of the stems), and oil (prepared from the fruits of the so-called oil palms). Only about one-half million dollars worth of dates are annually imported into the United States, but in the principal date-producing countries of the Old World enormous quantities are consumed, serving as one of the chief articles of food. Besides the large trade in fresh cocoanuts, large quantities of the meat of nuts are dried, yielding copra, of which Ceylon alone exports about forty-five million pounds an-

nually. In the cocoanut-oil industry, too, Ceylon ranks first, exporting annually over fifty-million pounds to be used largely for soap-making, but also, after purifying, in the preparation of butter substitutes. In addition, Ceylon exports yearly about thirty million pounds of coir, or cocoanut fiber, used chiefly in the manufacture of mats, ropes, and stuffing fiber. There should be mentioned also the ivory-nut palm, *Phytelephas macrocarpa,* which yields ivory nut—the hard ivory-like fruit of the plant—used in this country for making buttons.

While palms are important in our own country, they are vastly more so in the countries to which they are indigenous, where, as has been rather strikingly said, they furnish the natives with houses, clothing, food, and ornaments.

The following is a list of the seeds included in the collection, all of which appear on the two accompanying plates under the numbers indicated. Where two specimens occur in the plates under one number, the left-hand one is the complete fruit and the right-hand one the seed stripped of its husk or other covering. Where only one specimen appears under a given number this is the seed deprived of its covering. In a few instances three specimens appear under one number. In these cases the left-hand one is the complete fruit; the middle one the same but with the thin epidermal covering severed to expose the fibrous husk beneath; and the right-hand one the seed stripped of its husk.

PLATE 7 (*Frontispiece*)

(All specimens are figured about two-thirds natural size.)

1. ***Mauritia vinifera.***
2. ***Sagus Rumphii.***
3. ***Areca Catechu.***
4. ***Kentia Joanis.***
5. ***Acrocomia intumescens.***
6. ***Bactris Ottostaffeana.***
7. ***Cocos picrophylla.***
8. ***Cocos edulis.***
9. ***Polyandrococos caudescens.***
10. ***Latania edulis.***
11. ***Arikuryroba Capanemae.***
12. ***Cocos coronata.***
13. ***Cocos Romanzoffiana.***
14. ***Enterpe oleracea.***

PLATE 8

(All specimens figured practically natural size.)

15. ***Sabal Adansoni.***
16. ***Sabal serrulatum.***
17. ***Sabal princeps.***
18. ***Sabal havanensis.***
19. ***Licuala Jeanenceyi.***
20. ***Licuala Rumphii.***
21. ***Licuala horrida.***
22. ***Phoenix tomentosa.***
23. ***Phoenix spinosa.***
24. ***Kentia Macarthuri.***
25. ***Kentia Sanderiana.***
26. ***Kentia robusta.***
27. ***Pinanga Kuhlii.***
28. ***Licuala elegans.***
29. ***Oreodoxa oleracea.***
30. ***Pinanga patula.***
31. ***Desmonchus horridus.***
32. ***Oreodoxa regia.***
33. ***Pinanga maculata.***
34. ***Areca Luttensis.***
35. ***Trithrinax brasiliensis.***
36. ***Pinanga spectabilis.***
37. ***Neonicholsonia Georgei.***
38. ***Cocos odorata.***
39. ***Areca rubra.***
40. ***Livistona Hoogendorpii.***
41. ***Martinezia caryotaefolia.***
42. ***Latania borbonica.***
43. ***Caryota urens.***
44. ***Caryota plumosa.***
45. ***Corypha australis.***

PALM FRUITS AND SEEDS

THE BANANA

The luxuriance and thrift of the vegetation of the moist tropics is perhaps nowhere better exemplified in the Garden than in the collection of banana plants at present growing in the banana dome adjoining the orchid house. The thick fleshy trunks and the vivid green leaves of enormous size impress one as the very embodiment of tropical profusion. Although planted less than a year ago, some of the plants have already reached the roof of the house and a specimen of the red banana, *Musa sapientum* var. *rubra,* is bearing leaves three feet wide and ten feet long, not including the long petiole, or leaf stalk. A specimen of *Musa rhodochlamys* is in flower and should be observed from time to time in order to follow the development of the fruit. Also a plant of *Musa Martini* is just coming into flower.

The banana appears to have been one of the very earliest plants subjected to cultivation. Although a number of wild forms grow at the present time in many parts of the tropics, it is questionable whether any of these represent the ancestral type of the cultivated banana. Indeed, it is supposed by some that all of the present-day wild bananas are only cultivated forms which at some time or other escaped from cultivation, the ancestors of the cultivated banana having become extinct. It is generally supposed that the banana originated in the Indo-Malaysian region, where man is first thought to have attained a high degree of civilization. The fruits of the wild bananas are composed almost entirely of seeds with only a very small amount of sweet pulp, and it is therefore believed that the plants originally had but little value as fruit producers. Instead, it seems probable that the plants were first grown for the starchy roots and even for the tender heart of the stem, both of which are still utilized as food in certain localities.

The present-day cultivated banana fruit is seedless and contains a large amount of palatable pulp. The seedless habit seems to have been established a very long time ago, and coincident with it the increased development of pulp probably appeared; it would seem, therefore, that the banana became prized for its fruits rather than for its roots and stems at a very early date. Just how the present-day seedless but very pulpy banana has been derived from the originally abundant seed-producing varieties is much in dispute. By some it is considered that the lack of seed development has resulted from hybridization, as is not infrequently the case in cultivated plants, whereas others suppose that the seedless habit has resulted from the continued selection and vegetative prop-

agation of the more pulpy forms, a relatively easy method in the banana owing to the abundant production of suckers at the base of the older plant. Although the cultivated banana is ordinarily seedless, and in spite of the fact that this seedlessness has been established for a long time, the plants apparently are not sterile. While it is true that the commonly cultivated yellow banana, *Musa sapientum,* does not produce seed following pollination with its own pollen, it has recently been shown that when pollinated with the pollen of the distinct but equally seedless red banana, *Musa sapientum* var. *rubra,* abundant seeds are produced.

From Indo-Malaysia it is generally supposed that man carried the banana with him on his various migrations, both eastward to the islands of the Pacific and perhaps to America, and westward to India, the Mediterranean region, and finally to America. The banana is a plant which lends itself admirably to such journeys, since the suckers can be dried and carried for a considerable period of time without loss of vitality. While little is known concerning the eastward dispersal of the banana from Indo-Malaysia a very interesting, though somewhat fragmentary, record is left of its westward journey by the name Musa—the present generic name of the banana, which has come down to us through the Sanskrit "Moca," the Arabic "Mauz" or "Muz," and the Latin "Musa." Pliny describes a plant which is thought to have been the banana, the fruit of which he states was the food of the sages of India. It is because of this statement that the common cultivated banana has been named *Musa sapientum*—the musa of the wise men.

The banana is cultivated most successfully in moist tropical and subtropical regions, where it prefers a deep, rich, alluvial soil. In such situations it attains a height of 18-20 or more feet in twelve months. Although apparently possessed of a thick stout stem, the true stem is usually represented only by a bulbous underground structure, the aerial trunk being made up solely of the stout overlapping and concentrically arranged leaf bases which together form a firm trunk. At the time of flowering a tender stem is pushed up from the bulbous underground stem through the trunk and finally emerges at the top, where it bears the flowers and later the fruits. This flower stalk, however, is not large and lends little or no rigidity to the trunk. The top of the trunk is crowned with a rosette of enormous leaves—among the largest and most impressive known.

The blossoms of the banana are disposed in clusters spirally arranged about the central floral axis. (See lower right-

FLOWERING BANANA PLANT, MUSA RHODOCHLAMYS

hand figure of the accompanying plate.) While all of the flowers have an ovary, the length of the latter compared to the length of the entire flower varies according to the position of the flowers on the axis. At the base of the latter there are about 8-10 clusters the flowers of which bear ovaries about two-thirds the length of the flower. (See lower left-hand figure of the plate.) These ovaries give rise later to the "fingers," or individual banana fruits, while the clusters form the "hands." These fruit-producing flowers are the so-called female flowers though bearing defunct stamens. At the tip of the floral axis are borne the so-called male flowers, which are likewise crowded into clusters and are covered by large reddish scales. In these the ovary is only about one-third the length of the flower and falls, together with the remaining floral parts, after the pollen from the well developed stamens has been shed. Occupying an intermediate position on the floral axis are flowers again arranged in clusters but bearing ovaries about one-half the length of the entire flower. (In the lower right-hand figure of the plate the first of these clusters are just appearing.) These flowers are either perfect, i. e., bearing both stamens and ovary, or neuter, i. e., possessing neither stamens nor ovary. Such ovaries as are present usually enlarge somewhat and persist on the axis as small worthless fruits. The male flowers continue to open while the fruit of the female flowers is ripening, and at the time the fruit is ready to be cut the flower stalk is bearing the hands of full-grown bananas at the base, while on the long pendulous projecting portion the aborted fruits of the perfect flowers occur and at the tip the so-called "bud" of unopened male flowers. As the pendulous flower stalk first emerges, or "shoots," from the trunk, the ovaries hang down. As the stamens and perianth drop from the female flowers, however, the ovaries—future fruits—gradually turn upward (compare the two lower figures in the plate), and from this time on maintain this erect position.

For local use it is generally considered that the fruit has a better flavor if cut when "full," i. e., when it is still green but already of maximum size, and allowed to ripen off the tree. Where bananas are shipped over considerable distances, however, it is of course necessary to cut earlier, but in general the flavor and consistency of the fruit is impaired in proportion to the length of time it is cut before becoming "full." Usually about two and one-half to four months are required from the time of "shooting" until the fruit becomes "full."

Commercially, banana plants are grown from "suckers"—shoots which develop from the underground stems. When

starting plantations, suckers about eight months old are generally used and cut to within six inches of the underground stem, which has developed in the meantime at the base of each. Such suckers usually measure from eight to fourteen inches across the cut surface and are planted out about fifteen feet apart each way. A rich, moist but well-drained, alluvial soil is best adapted to banana culture and under these conditions the suckers above referred to usually yield fruit in from ten to fourteen months.

A single banana shoot bears fruit but once. In harvesting, the stem is partly cut through six or eight feet above the ground, after which the upper portion bearing the bunch slowly bends over to the ground. The bunches are removed and transported as rapidly as possible to the shipping points. During the growth of the banana plants numerous new suckers are produced. Most of these are carefully removed, but in order to insure a continuous stand of plants promising ones are left from time to time to successively take the place of the fruiting trunks when the latter are cut down at harvest time. While it is possible in this way to have a continuous succession of plants without replanting, it has been found necessary for various reasons to replant about every three to six years, depending on conditions.

Although the banana was apparently introduced into the West Indies early in the sixteenth century, the fruit as an article of export did not assume much prominence until the latter third of the nineteenth century. Some idea of the phenomenal growth of the banana trade in recent years may be gained when it is recalled that in 1867 the Governor of Jamaica in his Annual Report stated that the value of all fruit exported from that island during the year was only 728 pounds sterling. In 1911 Jamaica exported sixteen million bunches of bananas worth alone about seven million dollars. While Jamaica produces about twice as many bananas as any other country, the industry has assumed large proportions also in Costa Rica, Panama, Colombia, Cuba, Guatemala, Nicaragua, Honduras, and Santo Domingo. In 1912-13 these countries exported to the United States over forty-four million bunches valued at over fourteen million dollars. A much smaller but steadily growing export trade has sprung up with the European countries, though the Canary Islands still supply the great bulk of bananas for the European trade. Owing to the narrow frostless zone in the United States the banana is cultivated but little in this country and is found only in Southern Florida, the extreme southern portion of Louisiana, and southwestward to the Pacific.

Although somewhat deficient in protein and fats, the banana has a large carbohydrate content and possesses a relatively high food value, serving in some parts of tropical America as one of the principal food stuffs of the native population.

The banana is sometimes considered a difficult fruit to digest. It appears, however, that this usually finds its explanation in the fact that the fruit is eaten before it is thoroughly ripe. It is not uncommonly supposed that bananas which have become discolored and the pulp dark and soft, are beginning to decay. As a matter of fact such fruits have only just become thoroughly ripe and in this condition are far more digestible than in the firm yellow state. The green banana after being cut from the plant contains about one-fourth or one-fifth its weight in starch. During the process of ripening a very large percentage of this starch is converted into soluble sugar by certain enzymes, or ferments, present in the fruit. Furthermore, certain skeletal or fibrous constituents are converted into a soft more or less soluble substance which gives to the thoroughly ripe banana fruit a mucilaginous consistency. This process of ripening continues until the pulp becomes uniformly soft and usually somewhat dark colored. It has further been found that so long as the skin is intact decay-producing organisms do not appear in the pulp and that therefore no "rotting" in the ordinary sense of the term has taken place. In case the skin is broken and the pulp discolored, decay may indeed have set in and under these conditions the fruit is of course unfit for food.

An increasingly large quantity of bananas is yearly ground into flour. For this purpose full-grown unripe fruits are used, i. e., fruits in which the ripening process has not yet converted the starch into sugar. Banana flour is said to be very digestible and together with wheat flour is used to a limited extent for bread and cakes. Banana "figs," prepared by cutting ripe bananas lengthwise into four quarters and then drying them, are said to be very palatable and a considerable number of fruits are utilized in this way.

For various reasons about eight million bunches of bananas annually fail to meet the commendably high export standards. Some of the more common reasons for rejection are that the bunches are too small—less than six "hands," or that the fruits are not "full" enough or too ripe. Many attempts have been made to utilize these discards, and to a limited extent this has been realized in the manufacture of banana flour and banana figs. In addition, some of this

fruit is made into banana wine, principally for local consumption; a part of the unmarketable fruit, too, is used in the manufacture of banana whiskey and alcohol, though a considerable portion is still lost or utilized only as cattle food.

The bananas cultivated in the western hemisphere are almost exclusively the several varieties of *Musa sapientum,* and in the principal producing countries—Jamaica, Costa Rica, and elsewhere—the so-called Jamaican, or Gros Michel, banana predominates. In the Canary Islands, however, which furnish most of the fruit for European markets, the dwarf Chinese banana, *Musa Cavendishii,* is by far the more common. Specimens of both of these cultivated species are growing in the banana dome at the Garden, as well as a very large plant of the red banana, *M. sapientum* var. *rubra,* —the latter the largest specimen in the collection. Besides these seedless species the collection also includes specimens of *M. Martini, M. rhodochlamys, M. Arnoldiana,* and *M. Gilletii,* the latter two being African seed-bearing species grown from seed.

Of the interesting plants nearly related to the banana may be mentioned *Calathea Princeps* and *C. crotalifera,* specimens of both of which are growing in the aroid house. *C. crotalifera* is commonly called the rattle-snake plant on account of the floral spike with peculiar dry overlapping bracts. The specimen in the Garden is at present in flower and shows the "rattles" admirably. Specimens of *Strelitzia Nicolai,* from Africa and Australia, and *S. Reginae,* from South Africa, the latter the so-called "bird of paradise flower," will be found in the epiphytic orchid house. Attention was called to the latter plant in the February, 1913, number of the BULLETIN. Small specimens of *Heliconia Bihai* and *H. brasiliensis,* forms of wild plantain, as well as a collection of fancy-leaved marantas and calatheas, will also be found in the same house. In the palm house of the new conservatory are specimens of *Strelitzia Augusta* and *Ravenala madagascariensis,* both large-leaved plants which might easily be mistaken for banana plants. The latter is the traveler's tree, probably so called because of the water stored up in the long hollow leaf-stalks. Closely related to the banana and also of vast economic importance, but not represented in the Garden collection at the present time, is *Musa textilis,* the plant which yields Manila hemp.

FLORAL DISPLAY

Owing to the Quarter Centennial Celebration of the Organization of the Board of Trustees of the Garden, on Octo-

ber 15 and 16, the series of indoor floral displays will be inaugurated this year in October instead of in November, as heretofore. It will consist, in large part, of a collection of plants which reach their prime out of doors about the time of the early frosts, and will include numbers of potted specimen plants of canna, salvia, besides a collection of foliage plants. Under these conditions it will be possible to preserve the plants in good condition for a considerable time after frost has destroyed the plants out of doors. In addition, about 2,000 gladioli, in several varieties, 2,000 plants of *Torenia Fourneri,* and a collection of China asters will probably be shown, and together with the above plants are expected to provide an attractive exhibit at least until the opening of the chrysanthemum display in November.

As during the preceding year, the floral displays will be exhibited in the south wing of the new conservatories.

NOTES.

Mr. Alfred Rehder of the Arnold Arboretum, Harvard University, recently visited the Garden.

Mr. Paul C. Standley, of the U. S. National Herbarium, at Washington, D. C., recently spent a day at the Garden consulting collections in the herbarium.

Dr. David Griffiths, of the Office of Farm Management, Bureau of Plant Industry, U. S. Department of Agriculture, spent September 11 at the Garden studying types of cacti in the herbarium.

Mr. C. M. Baskett and a party of ladies, the wives of delegates to the convention of the Missouri Press Association, were recently conducted through the Garden by Mr. C. H. Thompson, Assistant Botanist to the Garden.

Mr. Carl Haltenhoff, of Gotha, Florida, a graduate of the Garden Course, visited the Garden on August 24 on his way to Marshall, Iowa, where he will engage in landscape work with Mr. A. H. Smith, also a graduate of the Garden Course.

Prof. A. S. Hitchcock, Systematic Agrostologist of the U. S. Department of Agriculture, together with members of his family, visited the Garden recently on his return to Washington, D. C., from a summer's investigation tour in the Northwest.

About fifty members and guests of the Engineers' Club of St. Louis visited the Garden on August 29 and were shown the various collections by especially appointed guides. Much

interest was displayed by the visitors in the thoroughly modern and efficient heating and watering facilities with which the greenhouses are equipped.

At the meeting of the Association of American Cemetery Superintendents to be held at the Garden on Thursday, October 9, Mr. John Noyes, Landscape Designer to the Garden, will read a paper on "Pictures in a Park Cemetery." At the same meeting, Mr. W. W. Ohlweiler, General Manager of the Garden, will read a paper on "Flower Displays without Rain."

STATISTICAL INFORMATION FOR AUGUST, 1914

GARDEN ATTENDANCE:

Total number of visitors	19,893

PLANT ACCESSIONS:

Total number of packets of seeds received	23

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	39
Total number of books and pamphlets donated	48

HERBARIUM ACCESSIONS:

By Purchase—

F. S. Collins—"Phycotheca Boreali-Americana," Fasc. XL, Nos. 1951-2000	50

By Gift—

J. A. Drushel—*Helianthus sp.* from Ohio	1
W. H. Emig—*Oenothera Hewetti* Cockerell and *O. Cockerelli* Bartlett & De Vries, from cultivated plants	6
G. D. Fuller—*Hosackia subpinnata* Torr. & Gray, from British Columbia	1
C. C. Hanmer—Specimens of *Stereum*	2
C. J. Humphrey—Specimens of fungi	24
E. O. Matthews—Specimens of fungi	9
W. W. Ohlweiler—*Lespedeza violacea* (L.) Pers. and *Vernonia Lettermanni* Engelm., from cultivated plants	2
Stuart L. Thompson—Flowering plants of Manitoba and Ontario	21

By Field Work—

Rev. John Davis—Plants of Missouri	660
	776

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Beginning with the first Sunday in April and continuing until November 30, the Garden will be open Sundays from 2 P. M. until sunset. Admission free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to November 1, starting from the main gate at 3 o'clock. Other trips may be arranged for by special appointment.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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Plant Breeding and Seeds.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. II OCTOBER, 1914 No. 10

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1914

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MAIDENHAIR TREE (*Ginkgo biloba*)

Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., October, 1914 No. 10

THE MAIDENHAIR TREE

Of the many trees which are worth while because of their beauty or usefulness, perhaps no single one is less known or appreciated than the so-called maidenhair tree *(Ginkgo biloba)*. In St. Louis, where hardy shade trees which combine beauty with resistance to disease and smoke are so much desired, the ginkgo deserves careful consideration. Certainly it would be hard to find another tree which is so free from both insect and fungous pests, stands the climate so well, and is apparently so unaffected by poisonous gases which are fatal to some of our most satisfactory trees. Combining these necessary qualities with unusual beauty, it would seem that the maidenhair tree should be more widely used. The only possible objection is that the fruit—which resembles a small yellow plum—is rich in butyric acid, and when ripe has an odor somewhat like that of rancid butter. So long as the fruit is on the tree, however, this odor is scarcely, if at all, noticeable, and if cleaned up soon after falling, need cause no trouble. Furthermore, the tree does not fruit until it is from twenty-five to forty years of age. If only male trees are grown, there is of course no difficulty of this kind, but the impossibility of distinguishing the male from the female in young trees makes it probable that a percentage of fruit-bearing ginkgos will be included in any plantation. In China the seeds of the ginkgo, after roasting, are esteemed as a dessert nut, it being supposed that the latter have some digestive property.

Young maidenhair trees are tall and slender, resembling the Lombardy poplar in type, but later horizontal branches appear which ultimately cause the trees to assume the appearance of spreading oaks. Ginkgos in this country from fifty to seventy-five years old measure forty to sixty-five feet in height and have trunks with a girth of from five to ten feet. Wilson, in his "A Naturalist in Western China," figures a tree of unknown age which is ninety feet tall and has a girth of twenty-four feet.

In the Missouri Botanical Garden there are a number

of fine specimens of this tree, and visitors are constantly commenting upon the singular character of their leaves, which are unlike those of any other American or European tree, reminding one of the maidenhair fern so much that the resemblance has given the ginkgo its common name. Although the ginkgo was at one time supposed to be a member of the pine family, the structure of the flowers, together with other peculiarities, has led to its placement in a separate division (the Ginkgoaceae) of the gymnosperms. It is not an evergreen, the leaves turning a beautiful yellow in the late fall before falling.

The maidenhair tree, together with the cycads, instead of following the method of fertilization in the higher plants, has retained the swimming antherozoids so characteristic of the ferns. The ginkgo and cycads thus form a most interesting bridge across the gulf which formerly was thought to separate the fern and fern-like plants from the seed-bearing plants. Although the habit and appearance of the tree are strongly suggestive of our deciduous flower and seed-bearing trees, the fertilizing apparatus is far more suggestive of the ferns and mosses, a reminder of the time when all plants were fitted for an aquatic habitat and provided with antherozoids possessing organs of locomotion with which to swim through the water to the egg cell.

Probably there is no other existing tree to which Darwin's term of "living fossil" may be so truly applied as the ginkgo. It is apparently the sole survivor of a race which narrowly escaped extinction, the reason for which we can only vaguely speculate upon. While fossil remains, found in the Palaeozoic, have led some to assume that the maidenhair tree could be traced back to this era, it is not until we come to the Mesozoic that the ancestry can be established with any degree of certainty. There is abundant evidence, however, of the practically world-wide distribution of members of the ginkgos in the oldest of the Mesozoic floras, and the remains of the leaves as well as the flowers and seeds indicate a surprisingly close resemblance to the existing maidenhair tree. It is as though a near relative of the Megatherium, or some other prehistoric monster, had managed in some unknown way to persist to the present date.

Although at one time growing from Australia, Cape Colony, and South America to northern Europe and all over North America to Greenland, the ginkgo in the present epoch was apparently confined to China and Japan. Even here it is not believed to exist wild, in spite of the statement of Mrs. Bishop, in her "Untrodden Paths of Japan,"

that she found forests of wild maidenhair trees. Wilson in his "A Naturalist in Western China" attributes the preservation of the ginkgo to the care of the priests. He says "The world at large does not realize how deeply it is indebted to religious communities for the preservation of many trees. In Europe, for example, most of the best varieties of pears originated in the gardens attached to religious establishments in France and Belgium and were introduced into England and other countries after the battle of Waterloo. In China, where every available bit of land is devoted to agriculture, quite a number of trees must long ago have become extinct but for the timely intervention of the Buddhist and Taouist priests. The most noteworthy example of this benevolent preservation is the maidenhair tree *(Ginkgo biloba)*. This strikingly beautiful tree is associated with temples and shrines, court gardens of palaces, and mansions of the wealthy throughout the length and breadth of China, and also in parts of Japan. But it is nowhere truly wild and is a relic of a very ancient flora."

From the Orient the ginkgo has again been distributed by cultivation until it is found over almost as wide an area as in Mesozoic times. It probably was brought to this country early in the last century, but no authentic account of its introduction can be found. The first tree which flowered in Europe appears to have been a male plant at Kew, which bore flowers in 1795. In France the ginkgo is commonly called *l'arbe aux quarante écus,* or "forty crowns tree," for the following reason, which is quoted from Loudon's interesting account:

"In 1870 a Parisian amateur named Pétigny made a voyage to London in order to see the principal gardens; and among the number of those he visited was that of a commercial gardener who possessed five young plants of *Ginkgo biloba,* which was still rare in England and which the gardener pretended that he alone possessed. These five plants were raised from nuts that he had received from Japan, and he set a high price on them. However, after an abundant *dejeuner* and plenty of wine he sold to M. Pétigny these young trees of ginkgo, all growing in the same pot, for 25 guineas, which the Parisian amateur paid immediately and then lost no time in taking away his valuable acquisition. Next morning, the effects of the wine being dissipated, the English gardener sought out his customer and offered him 25 guineas for one plant of the five he had sold the day before.

"This, however, was refused by M. Pétigny, who carried

the plants to France, and as each of them had cost him 120 francs, or forty crowns (quarante écus), this was the origin of the name applied to this tree, and not because it was originally sold for 120 francs a plant. Almost all the ginkgo trees in France have been propagated from these five imported from England by M. Pétigny. He gave one of them to the Jardin des Plantes, which was kept for many years in a pot and preserved through the winter in the greenhouse, till 1792, when it was planted out by M. André Thouin, who gave the above relation in his lecture; but as the situation was not at all favorable to it, this plant was not much above forty feet in height in 1834, and had not then flowered."

The ginkgo is easily propagated by budding or grafting, and, when possible, this method should be employed, because, of course, by this means female trees can be eliminated, thus removing the only possible objection to the tree. However, since the seed germinates so readily, most ginkgo trees are grown from seed, and it is well worth the while of everyone interested in trees to plant a few seeds of this unusually fine tree. While the Missouri Botanical Garden cannot undertake to send out seed, the surplus ginkgo fruit obtained from the trees in the Garden will be distributed this fall to those inquiring for them at the main gate. The seed should be kept dry during the winter and planted out early the next spring. A tree from eighteen inches to two feet in height may be expected the first season.

TWENTY-FIFTH ANNIVERSARY CELEBRATION

As announced in the BULLETIN for August, 1914, the Twenty-Fifth Anniversary of the organization of the Board of Trustees of the Missouri Botanical Garden was celebrated at the Garden on October 15 and 16. Although the foreign disturbances made it impossible for a considerable number of the European delegates to be present, the occasion proved to be one international in character and scope.

The following European botanists had originally accepted the invitation of the Board of Trustees to be present at the celebration and read papers at the scientific meetings: Director J. Briquet of the Jardin Botanique de la Ville Genève, Geneva, Switzerland; Professor Frederick Czapek of the Physiologisches Institut der Kaiserlich-Königlichen Deutschen Universität, Prag, Austria; Director Hans Fitting of the Botanische Anstalten der Universität Bonn, Bonn, Germany; Assistant Director Arthur W. Hill of the

Royal Botanic Gardens, Kew, England; Director Georg Klebs of the Botanisches Institut Universität Heidelberg, Heidelberg, Germany; Dr. Wladimir I. Lipsky of the Jardin Impérial Botanique de Pierre le Grand, St. Petersburg, Russia; and Professor N. Wille of the University of Christiania, Christiania, Norway. Similar acceptances had been received from two American botanists outside of the United States, Professor A. H. Reginald Buller of the University of Manitoba, Winnipeg, Canada, and Director Cassiano Conzatti of the Botanical Gardens of the State of Oaxaca, Mexico. But of all of these only Professor Wille was able to be present.

When it had become apparent that most of the foreign delegates would be prevented from taking part in the exercises, an invitation to participate in the celebration and present papers at the scientific meetings was extended to Director Johanna Westerdijk of the Phytopathological Laboratory, Amsterdam, Holland, and Geheimer Regierungsrat Dr. O. Appel of the Kaiserlichen Biologischen Anstalt für Land- und Forstwirtschaft, Berlin, Germany, both of whom happened to be in this country at the time of the celebration. Both accepted and were present to read papers.

All of the botanists of the United States who had accepted the invitation of the Board of Trustees to read papers at the scientific meetings of the anniversary celebration were present. These included the following: Professor George F. Atkinson of Cornell University, Ithaca, New York; Professor Charles E. Bessey of the University of Nebraska, Lincoln, Nebraska; Dr. N. L. Britton, Director in Chief of the New York Botanical Garden, Bronx Park, New York City; Professor John M. Coulter of the University of Chicago, Chicago, Illinois; Dr. D. T. MacDougal, Director of the Department of Botanical Research of the Carnegie Institution of Washington, Tucson, Arizona; Professor William A. Setchell of the University of California, Berkeley, California, and Dr. Erwin F. Smith of the Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C. In addition invitations to be present at the anniversary exercises were extended to all American botanists and to a limited number of other scientists.

Dr. W. G. Farlow of Harvard University, Cambridge, Massachusetts, in response to an invitation from the Board of Trustees, spoke in behalf of the American botanists at the Trustees' banquet, which marked the close of the anniversary exercises.

The celebration exercises opened on October 15 with an automobile tour of the city, starting from Hotel Jefferson at 10:30 A. M. A short stop was made at Washington University to allow the delegates and visiting scientists time for a brief inspection of the grounds and buildings of the University. The only other stop was made at the newly completed Barnes Hospital and Washington University Medical School. Through the kindness of Dean Opie and other members of the Medical School Faculty, the visitors were shown the splendid equipment and facilities of the hospital and the medical school. On the trip opportunity was also given the visitors to see Tower Grove Park, another of Mr. Shaw's splendid gifts to the people of St. Louis.

After the motor trip, luncheon was served at the Garden in the house erected by the founder of the Garden in 1849, and occupied by him as a country residence until his death, in 1889. Considerable interest was displayed by the visiting scientists in the historical collection, consisting of various portraits and articles which had belonged to Mr. Shaw, as well as autograph letters and books of interest to botanists, which was on exhibition in the old residence.

Dr. George T. Moore, Director of the Garden, opened the scientific meeting of the afternoon, held in the Graduate Lecture Room, with an address of welcome, after which the following papers were presented:

"THE VEGETATION OF MONA ISLAND"

Director in Chief N. L. Britton

New York Botanical Garden, Bronx Park, New York

"THE FLORA OF NORWAY AND ITS IMMIGRATION"

Professor N. Wille

University of Christiania, Christiania, Norway

"THE PHYLOGENETIC TAXONOMY OF THE FLOWERING PLANTS"

Professor Charles E. Bessey

University of Nebraska, Lincoln, Nebraska

1. "THE BOTANICAL GARDEN OF OAXACA"
2. "THE ORCHID AND ITS CULTIVATION"
3. "THE NEGLECTED CULTIVATION OF AN IMPORTANT HORTICULTURAL PLANT"

Director Cassiano Conzatti

Botanical Gardens of the State of Oaxaca, Mexico

(Read by Title)

"The Scientific Significance of the Imperial Botanic Garden of Peter the Great, with Special Reference to the Flora of Asia"

Dr. Wladimir I. Lipsky
Jardin Impérial Botanique de Pierre le Grand, St. Petersburg, Russia

(Read by Title)

"Comparative Carpology of Cruciferae with Vesicular Fruits—Some General Biological and Systematic Conclusions"

Director J. Briquet
Jardin Botanique de la Ville Genève, Geneva, Switzerland

(Read by Title)

"The Origin of Monocotyledony"

Professor John M. Coulter
University of Chicago, Chicago, Illinois

"The History and Functions of Botanical Gardens"

Assistant Director Arthur W. Hill
Royal Botanic Gardens, Kew, England

(Read by Title)

The first day of the anniversary celebration closed with a reception given by Dr. and Mrs. Moore in the Director's residence in the Garden.

With the exception of personally conducted trips through the conservatories and grounds of the Garden, no definite program was arranged for the forenoon of the second day of the celebration. This was done in order to give the visitors an opportunity to spend such time as they desired in the laboratories, herbarium, library, and Garden collections.

After luncheon, which was again served in the old residence, the visitors assembled for the second scientific program, which consisted of the following papers:

"Recent Investigations on the Protoplasm of Plant Cells and Its Colloidal Properties"

Professor Frederick Czapek
Physiologisches Institut der K. K. Deutschen Universität, Prag, Austria

(Read by Title)

"Experimental Modification of the Germ Plasm"

Director D. T. MacDougal
Department of Botanical Research, Carnegie Institution of Washington, Tucson, Arizona

"HORMONE IM PFLANZENREICH"
Director Hans Fitting
Botanische Anstalten der Universität Bonn, Bonn, Germany
(Read by Title)

"THE RELATIONS OF SCIENTIFIC BOTANY TO PHYTOPATHOLOGY"
Geheimer Regierungsrat Dr. O. Appel
Kaiserlichen Biologischen Anstalt für Land- und Forstwirtschaft, Berlin, Germany

"THE LAW OF TEMPERATURE CONNECTED WITH THE DISTRIBUTION OF MARINE ALGAE"
Professor William A. Setchell
University of California, Berkeley, California

"UEBER FORMBILDUNG UND RHYTHMIK DER PFLANZEN"
Director Georg Klebs
Botanisches Institut Universität Heidelberg, Heidelberg, Germany
(Read by Title)

"PHYTOPATHOLOGY IN THE TROPICS"
Director Johanna Westerdijk
Phytopathological Laboratory, Amsterdam, Holland

"PHYLOGENY AND RELATIONSHIPS IN THE ASCOMYCETES"
Professor George F. Atkinson
Cornell University, Ithaca, New York

"THE ORGANIZATION OF A MUSHROOM"
Professor A. H. Reginald Buller
University of Manitoba, Winnipeg, Canada
(Read by Title)

"A CONSPECTUS OF BACTERIAL DISEASES IN PLANTS"
Dr. Erwin F. Smith
Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

The celebration closed with the Trustees' Banquet on the evening of October 16, at the Liederkranz Club. The large ballroom had been converted into a veritable flower garden, and amid the forest of foliage plants which covered the stage a life-size portrait of the founder of the Garden had been so skillfully inserted that Mr. Shaw appeared to be in his garden welcoming the guests. Mr. Edwards Whitaker, President of the Board of Trustees of the Garden, was toastmaster of the evening, and in his opening address reviewed the life and work of Mr. Shaw and paid a high tribute to the philanthropy and far-sighted wisdom of the founder of the Garden. In concluding his address, Mr.

Whitaker proposed a silent toast to the memory of Henry Shaw.

The foreign delegates to the anniversary celebration—Dr. Westerdijk, Dr. Appel, and Dr. Wille—brought greetings from their fellow scientists and offered congratulations upon the achievements of the Garden during the first twenty-five years of the existence of the Board of Trustees. Other speakers of the evening were the Hon. Chas. Nagel, Capt. Henry King, Dr. W. G. Farlow, and Dr. George T. Moore.

In a number of the Annals of the Missouri Botanical Garden to be issued early in the next year, the papers read at the scientific meetings and the addresses made at the banquet will be printed in full.

The celebration brought together a most notable assemblage of men and women of science, four foreign countries — England, Germany, Holland, and Norway — being represented, as well as twenty-three of our own United States. The following is a list of the delegates and visiting scientists:

Mr. S. Alexander
Detroit, Michigan

Dr. Frank M. Andrews
Indiana University, Bloomington, Indiana

Dr. O. Appel
Kaiserlichen Biologischen Anstalt, Berlin, Germany

Dr. Charles O. Appleman
Maryland Agricultural Experiment Station, College Park, Maryland

Dr. J. C. Arthur
Purdue University, Lafayette, Indiana

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Laboratory of Phytopathology, Amsterdam, Holland

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University of Nebraska, Lincoln, Nebraska

Dr. N. Wille
University of Christiania, Christiania, Norway

Dr. William L. Woodburn
Northwestern University, Evanston, Illinois

Dr. R. B. Wylie
State University, Iowa City, Iowa

NOTES

The third number of Volume I of the Annals of the Missouri Botanical Garden has been issued with the following contents:

"Description of North American Senecioneae." J. M. Greenman, *Curator of the Herbarium.*

"A Study of the Physiological Relations of Sclerotinia cinerea (Bon.) Schröter." J. S. Cooley, *formerly Rufus J. Lackland Fellow in the Henry Shaw School of Botany of Washington University.*

"The Thelephoraceae of North America. II. Craterellus." Edward A. Burt, *Mycologist and Librarian to the Garden.*

"The Effects of Surface Films on the Rate of Transpiration: Experiments with Potted Potatoes." B. M. Duggar, *Physiologist to the Garden, in Charge of Graduate Labora-*

tory, and J. S. Cooley, *formerly Rufus J. Lackland Fellow in the Henry Shaw School of Botany of Washington University.*

Dr. George T. Moore, Director of the Garden, addressed the City Club, October 13, on "The Relation of the Missouri Botanical Garden to the City."

Professor C. S. Sargent of the Arnold Arboretum, Cambridge, Massachusetts, accompanied by Mr. Ames, spent a few hours at the Garden on October 22.

About one hundred members of the City Club of St. Louis visited the Garden on October 17, and were shown through the various conservatories and collections by Garden guides.

On the evening preceding the opening of the anniversary celebration, a smoker was given at the University Club for scientists who were in the city for the anniversary exercises.

Dr. George Grant Hedgcock, Pathologist in the Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C., recently spent several days at the Garden in a study of certain collections in the herbarium.

Classes from the following schools visited the Garden during the past month and were escorted by guides of the Garden: Mary Institute, Soldan High School, Sherman School, Horace Mann School, and Shenandoah School.

Dr. Lewis Knudson, Assistant Professor of Plant Physiology, Cornell College of Agriculture, Ithaca, New York, is spending a six-months' leave of absence from his University at the Garden, pursuing investigations in the graduate laboratory.

A circular of general information concerning the Garden has been prepared for distribution to visitors to the Garden. The leaflets will be handed to visitors upon entering the Garden at the main gate. Attention is called to the copy of the circular inserted in this number of the BULLETIN.

On Wednesday, October 14, Professor Charles E. Bessey of the University of Nebraska, Lincoln, Nebraska, addressed the faculty and students of Washington University on "From Moscow to Ararat; a Professor's Journey through Russia." Professor Bessey was in St. Louis as a delegate to the anniversary celebration of the Garden.

Dr. Johanna Westerdijk, Director of the Phytopathological Laboratory, Amsterdam, Holland, and Geheimer

Regierungsrat Dr. O. Appel of the Kaiserlichen Biologischen Anstalt für Land- und Forstwirtschaft, Berlin, Germany, foreign delegates to the anniversary celebration, spent several days, following the exercises, at the Garden.

The annual chrysanthemum display, which is one of the largest exhibits in the regular series of Garden floral displays, will begin on the first Sunday in November and continue for two or three weeks. The exhibit will consist of about 2,500 plants, the latter comprising upwards of 500 varieties. Especial emphasis has been placed this year on the yellow varieties, an unusually fine collection of which will be shown.

Professor N. Wille of the University of Christiania, Christiania, Norway, who was a delegate to the quarter centennial celebration, and Mrs. Wille remained in St. Louis a week following the close of the anniversary exercises. Professor Wille spent a considerable part of this time at the Garden engaged in an examination of the local algal flora. Professor Wille's favorite field of investigation is that of the fresh-water algae, in which he is a recognized authority.

As a result of the competitive Garden scholarship examinations, held on the first Saturday in September of this year, scholarships were awarded to Mr. Clarence Pedlow of Indianapolis, Indiana, and Mr. Paul A. Kohl, of St. Louis. Besides the four students already holding scholarships, and Mr. Pedlow and Mr. Kohl, Miss Clara Fuhr of Augusta, Missouri, Mr. M. Stoffey of Chicago, Illinois, and Mrs. Walter Goodwin and Mr. C. W. Buente, both of St. Louis, reported for the new Garden courses in horticulture and landscape gardening, on October 1.

The suggestion having been made that following the exercises of the twenty-fifth anniversary celebration of the Garden a reorganization of the Association of Central States Botanists be effected, the Garden extended an invitation to this society to hold its meetings in the Garden. The meeting was held at the Garden on Saturday, October 17, the day following the close of the anniversary exercises, and was largely attended by a representative group of botanists. Luncheon was served to the visiting botanists by the Garden in the old Shaw residence. Dr. E. A. Burt, Mycologist and Librarian to the Garden, was elected secretary of the organization.

STATISTICAL INFORMATION FOR SEPTEMBER, 1914

Total number of visitors.....18,163

PLANT ACCESSIONS:

Total number of packets of seeds received in exchange.....	78
Total number of plants donated.....	95

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought.....	28
Total number of books and pamphlets donated.....	169

HERBARIUM ACCESSIONS:

By Purchase—

A. A. Heller—Plants of California.....	400
F. C. Seymour—Plants of Massachusetts.....	124

By Gift—

J. C. Arthur—Parasitic fungi.....	11
L. M. Dougan—*Solidago serotina* Ait. from Missouri.....	6
J. A. Drushel—Plants of Ohio and Michigan.....	8
W. H. Emig—Fungus from Illinois.....	1
C. J. Humphrey—Fungi from Michigan, Wisconsin, Illinois, Iowa, and Minnesota.....	68
C. J. Humphrey—Fungi from Louisiana.....	29
C. J. Humphrey—Fungi from Montana, Colorado, New Mexico, and Arizona.....	32
C. J. Humphrey—Fungi from Washington, Oregon, and California.....	32
Mrs. Kaufmann—Fungi from Missouri.....	3
T. C. Meyer—Fungi (3 edible and 2 poisonous species).....	6
W. W. Ohlweiler—Cultivated plants showing leaf variation.	25
Norma E. Pfeiffer—*Thismia (Bagnisia) americana* Pfeiffer from Illinois.....	1
J. R. Schramm—Ferns and flowering plants of Colorado...	4
H. von Schrenk—Fungi from Austria.....	46
H. von Schrenk—Fungi from New England, New York, Wisconsin, and Missouri.....	455

BY FIELD WORK:

Rev. John Davis—Flowering plants of Missouri.....	704
Rev. John Davis—Parasitic fungi from Missouri.....	4
TOTAL.....	1,959

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Beginning with the first Sunday in April and continuing until November 30, the Garden is open Sundays from 2 P. M. until sunset. Admission free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to November 1, starting from the main gate at 3 o'clock. Other trips may be arranged for by special appointment.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

☛ **The Garden will be open all day Thanksgiving day, November 26.**

STAFF
OF THE MISSOURI BOTANICAL GARDEN

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GEORGE T. MOORE.

Assistant to the Director.

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Recording and Labeling.

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Construction.

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Orchids and other Exotics.

P. FOERSTER,
Farm and Stables.

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Outside Floral Displays.

K. N. SVETLIKOFF,
Plant Breeding and Seeds

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. II NOVEMBER, 1914 No. 11

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ST. LOUIS, MO.
1914

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WARDIAN CASE WITH GLASS FRONT REMOVED
(PACKED READY FOR SHIPMENT)

Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., November, 1914 No. 11

THE WARDIAN CASE

Several valuable collections of economic plants, from all parts of the world, among them mangosteens from Ceylon and cycads from Australia, have been successfully imported by the Garden. The healthy condition in which the plants arrived after their long journey is to be attributed largely to the use of Wardian cases in the shipment. Without these cases it would have been well nigh impossible to add these living specimens to the Garden collection.

This most satisfactory method of shipping living plants long distances we owe to Mr. N. B. Ward, F.L.S., of London, who conceived the idea in consequence of a simple incident which occurred in his laboratory in 1829. He states: "I buried the chrysalis of a sphinx in some moist mould contained in a wide mouthed bottle covered with a lid, watching the bottle from day to day. I observed that the moisture which during the heat of the day arose from the mould, became condensed on the internal surface of the glass, and returned whence it came; thus keeping the mould always in the same degree of humidity. About a week prior to the final change of the insect, a seedling fern (prothallus) and a grass made their appearance on the surface of the mould." These two plants were kept in this jar for nearly four years, and Mr. Ward began a series of experiments in his laboratory on growing plants in closed cases.

About this time Mr. Ward's attention was called to the loss, due apparently to a lack of light or of water or of both, of the entire collection of plants made by Menzies during his trip around the world. Thereupon Mr. Ward investigated means of conveying plants and seeds across the ocean. He states: "It was obvious that my new method offered a ready means of obviating all these difficulties, so far at least as regarded ferns, and plants growing in similar situations; and in the beginning of June, 1833, I filled two cases with ferns, grasses, etc., and sent them to Sydney in care of my zealous friend, Capt. Mallard." The outcome of the experiment is given in a letter from the Captain in 1833.

"You will, I am sure, be much pleased to hear that your experiment for the preservation of plants alive, without the necessity of water or open exposure to the air, has fully succeeded. The two boxes entrusted to my care, containing ferns, mosses, grasses, etc., are now on the poop of the ship (where they have been all the voyage); and the plants (with the exception of two or three ferns which appear to have faded), are all alive and vigorous.

"During the very hot weather, near the equator, I gave them a light sprinkling of water, and that is all they have received during the passage. All the plants have grown a great deal, particularly the grasses, which have been attempting to push the top of the box off.

"I shall carry them forward to Sydney, according to your instructions, and have no doubt of delivering them into the hands of Mr. Cunningham in the same flourishing state in which they are at present.

"Allow me, in conclusion, to offer you my warn congratulations upon the success of this simple but beautiful discovery for the preservation of plants in the living state upon the longest voyages; and I feel not a little pride in having been the instrument by which the truth of your new principle has been fully proved by experiment."

As confirmation of the success of the experiment, Mr. Ward had the cases refilled with Australian plants and shipped from Syndey to London in February, 1834, the temperature at the former port ranging from 90 to 100° F.

During the eight months of the trip various changes of temperature were experienced, from 20° F., at Cape Horn (where a severe snowstorm was encountered), to 100° F., at Rio Janeiro, and 120° F., at the equator, and finally to 40° F., in the English Channel. The cases were left on deck during the entire voyage, and no water was supplied to the plants, which nevertheless were in a healthy and vigorous condition when unpacked at their destination. Several plants of *Callicoma serrata* had even grown from seeds.

The British government readily accepted these miniature greenhouses for use in long-distance shipments, and began sending plants to the colonies from Kew Gardens. It was the Wardian case which made possible the introduction of the quinine plant *(Cinchona succirubra)* into India from South America. Plants and seeds were received at Kew Gardens in 1860, and in the following year 2170 seedling

plants were shipped, in Wardian cases, to India. Thirty years later, in 1892, the drug prepared from these plants was sold, in five-grain doses, at most of the post-offices in the province of Bengal for the price of one pice—about half a cent—which means that this most beneficial medicine in the cure of the commonest and most fatal of Indian diseases was put within reach of the poorest Hindu.

The Wardian case also made possible the introduction of the Para rubber plant *(Hevia brasiliensis)*, into Ceylon. Seeds were collected in the vicinity of the River Tapajos, Brazil, shipped to Kew where upwards of 1000 seeds germinated, and the young plants sent to Ceylon, August 12, 1876, in thirty-eight Wardian cases, which were especially constructed on account of the rapid growth of the seedlings. And ninety per cent of the plants reached Ceylon in excellent condition. Without the Wardian cases, these two introductions would probably have shared the fate of the many earlier ones.

The construction of a Wardian case is a simple matter. Except that the ends are solid, it may be compared to a miniature even-span greenhouse, the base representing the side walls and floor of the greenhouse. The roof is made of two separate frames, which fit on the ends and meet at the top, forming a ridge. These frames are glazed and the glass is protected on the outside by thin pieces of wood, so placed as to admit the maximum amount of light. One or both of these sash-frames are removable for purposes of packing and unpacking. The bottom of the case is filled with moist peat soil, cocoanut fiber, or light soil. The plants are planted in this material and held in position by narrow strips of wood, which in turn are firmly secured by cross strips nailed to the sides of the case. With the exception of a small plate of perforated zinc in each end, the case is practically air-tight, so that but little escape of water or change of air can take place in transit. Plate 11 illustrates a packed Wardian case, with the glass front removed.

FLORAL DISPLAYS

As announced in the BULLETIN for September, the practice, inaugurated two years ago, of holding a continuous series of floral displays from November to June is being carried on during the present season. All of these exhibits are held in the floral display house, which constitutes the south wing of the new conservatory.

The chrysanthemum exhibit, which has just passed, was the first of this series of monthly floral displays for which the Garden is preparing. For nearly ten years it has been an annual event in the Garden, which has become well known to St. Louisians as the Chrysanthemum Show, and at one time constituted the one conspicuous floral event of the year. The increasing interest manifested by the public in the continuous series of exhibits held during the last two years has prompted the Garden to make even larger plans for the coming displays, which will include many plants new to the general public. The usual flowers of the season will be on exhibit, but as it is the aim of the Garden to educate as well as to interest, particular attention will be paid to the uncommon plants.

Few people realize the amount of study necessary to have plants flower at definite periods. Preparations for the November display of chrysanthemums were begun early last January, since when the plants have been carefully tended, and when large enough many were shaped by tying on wire forms. From others all side buds were removed immediately they appeared in order that the vigor of the plant might be concentrated in the development of a single blossom. The application of suitable fertilizers and the removal of the plants from time to time to larger pots to accommodate the enlarging root systems are also important factors in chrysanthemum culture. Eleven months of constant care were necessary to bring the plants of last month's display into flower, and plans are already being formulated for the exhibit of next November.

What is true of the growing of chrysanthemums is true also of other flowering plants, many of which come from abroad and must, therefore, be ordered many months before they are needed. The time required to grow plants from seeds or bulbs to maturity varies considerably with the different kinds. Lily-of-the-valley bulbs can be brought into flower in a little over two weeks; tulips, hyacinths, narcissus, and many of the lilies require more time, many of them being already potted and stored in cold frames, although not intended for display until spring. In the meantime these bulbs will develop root systems, and when brought into the hothouse and subjected to higher temperatures, will blossom within a few weeks. The handling of such material is an art which is achieved only with long experience, there being no hard and fast rules which insure success.

Two other factors of great importance in growing plants are temperature and light. Ordinarily the former may be

regulated with sufficient accuracy in the average greenhouse, though sometimes, even in winter, it may be impossible to prevent an undesired rise in temperature. This rise tends to throw flowering stock ahead of, rather than behind, the schedule, as was the case with the chrysanthemums this season. While such disturbances are undesirable from the standpoint of the Garden, they are frequently disastrous for the practical grower in that they sometimes so hasten or delay flowering that plants in great demand for special short seasons are not in a salable condition at the proper time.

Light is an important factor, since it may affect both the size and number of the blossoms, and the time of their opening. Dull, cloudy weather retards the opening of the flowers and frequently decreases their size, whereas bright weather tends to hasten flowering and increase the dimensions of the blossoms. The influence of dull weather is more perceptible in late fall and mid-winter than at any other time of the year. And, unfortunately, the condition is complicated by the fact that plants regularly develop very slowly at this period, more rapid growth not beginning until January. This is evidenced by the fact that January or February seedlings sometimes surpass in growth those from seed sown early in December.

A list of the plants to be exhibited during the present season is appended. Slight variations in this schedule, due to conditions not under control, will be understood from the preceding paragraphs. Announcements of any necessary changes will be made in the BULLETIN. In addition to the plant names a few notes are given in connection with the individual varieties, indicating the time and method of propagation.

December.—Five hundred Lorraine begonias, from leaf-cuttings of plants which flowered last winter; cuttings started in March. Six hundred solanums, from seed sown in April. Seven hundred poinsettias, grown from cuttings made in June. Five hundred stevias, from cuttings made in April.

January.—Eight hundred cyclamen, from seed planted in August, 1913. Seedlings from this August's sowing are now growing for display in January, 1916. One hundred and sixty azaleas, from stock which is kept from year to year. In St. Louis these plants require protection from too much sun. The fall buds may be made to blossom by raising the temperature of the house. Three thousand lily-of the-valley, grown from imported flower buds called "pips."

These will come early in December, and but a few weeks will be required to bring them into flower. One thousand freesias; bulbs planted in October. One hundred syringas, imported plants grown in pots. They are kept dormant in cold frames until three or four weeks before the exhibit, when they are subjected to higher temperatures to force flowering.

February.—Six hundred spiraeas; these plants will be potted upon their arrival, and will be in full bloom twelve or fourteen weeks later. One hundred dielytras, at present potted and placed in cold frames; blossoms can be forced in seven or eight weeks. Five hundred schizanthus, grown from seed sown in September. Five hundred *Lilium Harrisii* and five hundred *Lilium formosum,* will be potted upon arrival, placed in cold frames, and brought into flower when desired, probably late in February.

March.—One hundred amaryllis, grown from old stock plants. One hundred daedalacanthus, grown from cuttings made in April. Eight hundred nemesias, to be grown from seed not yet sown. One thousand *Primula malacoides,* from seeds sown in April. One thousand cinerarias, grown from seed sown in September.

April.—Eight hundred felesias, from cuttings made in late November and early December. Eight hundred antirrhinums, grown from seed sown last September. Five hundred marguerites, from cuttings made during October and November. Seven hundred fuchsias, from cuttings to be made in December. Six hundred Martha Washington pelargoniums, grown from cuttings made in the early fall.

May.—Three hundred tuber begonias, tubers of which are bought during the winter and forced into flower in about eight weeks. Five hundred gloxinias, seeds already planted. Seven hundred calceolarias, from seed planted in September. Eight hundred hydrangeas, grown from old stock. One hundred achimenes; method of growing similar to that described under tuber begonias. One hundred gesnerias, grown as above. One hundred St. Paulias, not yet started.

Summer 1915.—Eight hundred coleus, 300 crotons, 200 fancy-leaved caladiums, 200 rex begonias, 100 *Euphorbia heterophylla,* 100 *Euphorbia marginata.* With the exception of the crotons, which are grown from the same stock, year after year, none of these summer plants have been started.

In addition to the plants enumerated above, smaller quantities of many other flowering plants will be shown.

Owing to the very special requirements of the orchids as regards temperature, moisture, and light, these plants, which during December and January form one of the most beautiful and interesting floral displays of the year, can not be exhibited in the floral display house. A special house is provided for these plants at the east end of the old range of conservatories. While it is true that the flowering season of the orchids is at its height in mid-winter, some of these remarkable plants may be seen in flower at all times.

NOTES

Dr. R. Ruggles Gates, of the University of London, formerly Research Assistant at the Missouri Botanical Garden, is working in the herbarium and library.

At the annual meeting of the Sherman School Patrons' and Teachers' Association, on the evening of November 11, Dr. George T. Moore, Director of the Garden, spoke on the Garden and its activities.

Mr. Ernest J. Palmer, collector for the Missouri Botanical Garden in coöperation with the Arnold Arboretum, is spending a few weeks at the Garden, working over the plants collected during his recent trip through the Southwest.

Mr. Peter Bissett, of the Office of Foreign Seed and Plant Introduction, U. S. Department of Agriculture, visited the Garden on November 11. The Garden has from time to time obtained various interesting tropical plants through this office.

The December floral display, in addition to the usual poinsettias and other plants showing the Christmas colors, will be particularly attractive because of the large number of Lorraine begonias which constitute probably the finest lot of these plants ever shown in St. Louis.

A large number of out-of-town visitors, as well as pupils from the city, who were gathered for the celebration of the fiftieth anniversary of the organization of the St. Louis College of Pharmacy, visited the Garden on the afternoon of November 11, and were shown about by special guides.

Classes from the following schools visited the Garden during the past month and were conducted by Mr. Thompson to the various collections of plants of special interest to school children: Grant School, Devonshire School and Gar-

field School. In addition about 3,000 school children visited the Garden during the month to view the chrysanthemums.

The November number of Park and Cemetery contains various references to the visit of the members of the Association of American Cemetery Superintendents to the Garden, as well as snap-shots of both the outdoor and indoor collections. The paper read at this meeting by Mr. John Noyes, Landscape Designer to the Garden, on "Pictures in Park Cemeteries" is likewise published in this number.

The Missouri Botanical Garden Students' Club was organized on the evening of November 5, Mr. Fred Grossart, President, Mr. Paul A. Kohl, Secretary and Treasurer. After a few opening remarks by Dr. George T. Moore, Director of the Garden, Mr. Fred Grossart gave an illustrated talk on "The Chrysanthemum." At the meeting held November 19, the following program was presented: "Introduction of Tropical Plants" by Mr. W. W. Ohlweiler, General Manager to the Garden; "Insects Affecting Tropical and Semi-Tropical Plants in the Greenhouses," by Mr. Carl Giebel.

STATISTICAL INFORMATION FOR OCTOBER, 1914

Total number of visitors 20,448

PLANT ACCESSIONS:

Total number of packets of seeds received in exchange	6
Total number of plants donated	669

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	5
Total number of books and pamphlets donated	53

HERBARIUM ACCESSIONS:

By Purchase —

E. Bartholomew — "Fungi Columbiana," Century XLIV, Nos. 4300-4400; and Century XLV, Nos. 4401-4500	200
S. S. Visher — Plants of British Columbia, Washington, Alaska, etc.	845

By Gift —

S. Alexander—*Quercus* and *Helinathus* from Michigan	3
B. F. Bush—*Ithyphallus impudicus* (L.) Fries from Courtney, Missouri	1
I. W. Clokey—Flowering plants of Illinois and Canada	72
S. Davis—Fungi from Massachusetts	5
J. Dearness—*Thelephora intybacea* from Canada	1
J. A. Drushel—*Drosera* and *Sarracenia* from Alabama	7
C. Garrett—Flowering plants from Missouri	27
C. C. Hanmer—Fungi from Shelton Island, New York, and from Connecticut	10
F. Hemm—Plants of Kansas	109
Mrs. Harry January—*Fraxinus sp.* from Missouri	1

E. O. Matthews—Fungi and lichens from Mexico..... 8
L. Matthews—Parasitic species of Polyporus from St. Louis, Missouri 2
Mrs. McKittrick-Jones—Cultivated specimen of *Betula alba* L. var *pendula laciniata* Hort..... 2
G. E. Morris — Fungi from New Hampshire and Massachusetts 14
A. Nelson—*Merulius lachrymans* from Wyoming..... 1
G. L. Peltier—Fungi from Illinois..... 2
H. H. Smith—Photograph of *Solanum aciculare* Forst. from specimen collected in California..... 1
U. S. Dept. of Agriculture—*Stereum rameale* from Maryland 1
J. R. Wier—Fungi from Idaho..... 61

By Exchange —
U. S. National Museum—Photographs of type specimens.. 3

TOTAL..... 1,376

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission free. Beginning with the first Sunday in December and continuing until April 4, the Garden is closed Sundays.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,

GEORGE T. MOORE.

Assistant to the Director,

JACOB R. SCHRAMM.

BENJAMIN M. DUGGAR,
Plant Physiologist.

EDWARD A. BURT,
Mycologist and Librarian.

HERMANN VON SCHRENK,
Plant Pathologist.

CHARLES H. THOMPSON,
Assistant Botanist.

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Curator of the Herbarium.

MELVIN C. MERRILL,
Research Assistant.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

H. M. BIEKART,
Shrubs, Trees, and Nursery.

C. W. HOFFMAN,
Carpentering Department.

E. D. EMME,
Recording and Labeling.

W. F. LANGAN,
Engineer.

C. R. FOLLEN,
Construction.

G. H. PRING,
Orchids and other Exotics.

P. FOERSTER,
Farm and Stables.

M. SCHILLER,
New Conservatories

C. W. GARRETT,
Outside Floral Displays.

K. N. SVETLIKOFF,
Plant Breeding and Seeds

MISSOURI BOTANICAL GARDEN BULLETIN

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ST. LOUIS, MO.
1914

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BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

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Missouri Botanical Garden Bulletin

Vol. II St. Louis, Mo., December, 1914 No. 12

THE GARDEN COURSE

It was near the middle of the last century when Henry Shaw began the development of his country home—Tower Grove. From the very first he employed gardeners, and it appears that he found most of them lacking in the fundamental training so necessary for the work.

It is natural, then, that in planning the Garden and its future growth Mr. Shaw should have had in mind the development of more efficient garden labor, and in drawing up his will, January 26, 1885—nearly five years before his death—he inserted this paragraph:

> **"I declare my intentions that instruction to garden pupils shall be attended to, both in practical and scientific horticulture, agriculture and arboriculture * * * * I leave the details of instruction to those who may have to administer the establishment, and to shape the particular course of things to the condition of the times."**

The Board of Trustees, on assuming control of the Garden, gave this feature of his will their very early consideration. In December, 1889, the first announcement concerning Garden pupils was issued. In this we find the following:

> **"In accordance with the intentions of its honored Founder, the Trustees of the Garden propose to provide adequate theoretical and practical instruction for young men desirous of becoming gardeners."**

To this end certain resolutions were adopted at a meeting held November 19, 1889. Briefly summarizing these, they amount to this: That there be established the number of six scholarships for Garden pupils of the Missouri Botanical Garden to be available on and after April 1, 1890, to young men between the ages of fourteen and twenty years; and that each scholarship may be held for a period not exceeding six years. Under this arrangement the Garden pupils, for the first year of their course, were regarded as apprentices and, as such, were required to work under the direction of

the Head Gardener, performing the duties of garden hands. Manual labor was also required during the five morning hours throughout the remaining years of the course, while the afternoons, after the first year, were devoted to the study of horticulture, forestry, botany, and entomology, under the direction of the Director of the Garden, twenty courses being offered during the five years. In closing, this first announcement states:

> **"It is not intended to make botanists or other scientific specialists of the garden pupils, but, on the contrary, practical gardeners."**

Two years later the course was changed from one of six years to one of four years. The subjects offered are practically the same, though necessarily considerably condensed. In the announcement for that year (1893) there appears for the first time a definite working schedule for classes.

In 1895 and 1897 the course was slightly readjusted but not materially changed, and from this time on it remained practically stationary for a number of years—in fact, up to the time of change in the Garden's administration. A fair example of the course of study offered during this earlier period may be found in the one announced for 1910. Here the schedule provides for twenty-four courses. Of these gardening proper occupied 7, botany in different forms, 13; entomology, 1; bookkeeping and garden accounts, 2; and surveying and drainage, 1. Considered from the standpoint of the amount of time expended, the different courses occupied the following number of periods: Gardening, 30; botany, 32; entomology, 6; bookkeeping and garden accounts, 3; and surveying and drainage, 6.

Throughout this period elementary botany and plant physiology were given in the Shaw School of Botany, supplemented by more extended work in plant analysis, under various topics, conducted at the Garden by one of the Garden staff. All other subjects were given at first by one of the horticulturists and later by the Superintendent, in addition to his many other duties.

Such, in brief, were the conditions under which the past students pursued their work. With the changes in the Garden management has come a corresponding change in the course of study offered to Garden pupils.

At a meeting of the Board of Trustees, March 11, 1914, an entirely new course of instruction was adopted. Among the new features of the schedule which may be mentioned are the following: The elimination of the first year—heretofore given to manual labor alone, the course now covering

three years instead of four or six. Half of the time is given to practical manual work and half to class work. The remuneration is uniform—$350 per annum—for all those holding scholarships. All scholarships are awarded by the Director of the Garden under certain conditions which give fair and equal advantages to all candidates. Besides being open to the holders of the six scholarships provided, the course is open to others who may desire to pursue the work in full or in part. In addition to strengthening and augmenting the courses, the standard for admission has likewise been raised. The candidate must now be a graduate of a regular high school of recognized standing, or its equivalent, and the minimum age for entrance is sixteen years.

A considerable increase has also been made in the corps of instruction. In the past the work has been given by two or three or possibly four instructors—one man usually giving the major portion. Now this work is assigned to nine men, as follows, the numbers following the names indicating the number of courses given by each member of the corps of instruction: Dr. Moore, 1; Dr. Burt, 1; Dr. Schramm, 1; Mr. Thompson, 2; Mr. Ohlweiler, 7; Mr. Noyes, 8; Mr. Erdman, 5; Mr. Svetlikoff, 2; Mr. Biekart, 2; and Mr. Biekart and Mr. Ohlweiler, 2.

In addition to these regular courses, practical instruction is given concerning orchids, exotics, and water gardens by Mr. Pring, palms, ferns and floral displays by Mr. Schiller, and roses and medicinal and herbaceous collections by Mr. Garrett. This work has been divided into definite groups, or phases, of gardening, and each group, with its articulating subjects, is under the management of a man particularly fitted for the work assigned him. No more work is expected of any one man than he can properly attend to along with his other regular garden duties.

A comparison of the present schedule with the one given above of the former arrangement of courses may be interesting. The courses now embrace the following five general subjects, the numbers following having reference to the number of periods devoted to each subject: Gardening, all phases, 51; botany, 11; entomology, 2; engineering and surveying, 4; and drawing, 4.

It will be noted that there is a considerable reduction in the amount of time given to purely scientific subjects and a corresponding increase in time given to gardening subjects. This not only more nearly complies with the ideas suggested by Mr. Shaw, but also gives to the student the knowledge that is most useful in pursuing the profession after leaving

the Garden. The whole course is designed to give the student a broad and yet detailed knowledge of gardening in all its phases, and so prepare him that he may go from the Garden into practical work with the assurance and confidence that he understands the tasks set before him and the best way to accomplish them.

REUNION AND ORGANIZATION OF THE FORMER GARDEN PUPILS

This being the quarter-centennial anniversary year at the Garden and the year in which the reorganization of the school for gardening has taken place, it seemed a peculiarly appropriate time for the bringing together of those who had formerly taken the Garden course. During the summer some of the graduates from this course expressed their desire to organize in order that the relationship between the Garden and its pupils might be strengthened. Accordingly, a committee, consisting of Professor Arthur T. Erwin, of Ames, Iowa, Professor Arno H. Nehrling, of Amherst, Massachusetts, Mr. A. R. Gross, of Morgan Park, Chicago, Illinois, and Mr. Peter Pfaender, of St. Louis, Missouri, was appointed, which called a meeting for November 27.

About thirty pupils and instructors were present at the Hotel Jefferson on the morning of November 27, and, after an automobile ride through the city, assembled at the Garden for luncheon, which was served in the old residence.

After luncheon, all gathered in the graduate lecture room, where a temporary organization was effected by electing Professor Erwin temporary chairman, and Mr. Gross temporary secretary. Dr. George T. Moore, Director of the Garden, gave an address of welcome, which was responded to on behalf of the students by Professor Arno H. Nehrling. The roll of the former students was then called by the temporary secretary, and many of those present responded by relating interesting experiences; in addition a number of communications were read from some of those unable to attend. A permanent organization was effected by electing Professor Arno H. Nehrling President, Professor A. T. Erwin Vice-President, and Mr. Arthur R. Gross Secretary and Treasurer. Miss Eda A. Sutermeister was elected to the office of Historian.

In the evening all of the pupils, together with the members of the Garden staff, invited guests, and the employes of the Garden, assembled at the University Club for the annual Gardeners' Banquet. As provided for in Mr. Shaw's will, the Director of the Garden presided. Interesting remarks on the Garden school and its pupils were made by Professor

John C. Whitten, of the University of Missouri, Professor Arthur T. Erwin, and Mr. Arthur R. Gross. The meeting was marked by much enthusiasm, and it was felt by all that the new organization had been most successfully launched.

The first part of the morning of Saturday, November 28, was spent viewing the Garden, and at ten o'clock the pupils again assembled in the graduate lecture room to listen to a paper on School Gardens by Mr. H. C. Irish. Mr. Irish, who is in charge of the school gardens for the Board of Education of the City of St. Louis, discussed in detail his own work as well as the conditions in other large cities. Mr. C. H. Thompson, Assistant Botanist to the Missouri Botanical Garden, who has been an instructor in the Garden school for a number of years, reviewed the work given in the Garden course since its organization. An abstract of Mr. Thompson's remarks will be found in this number of the BULLETIN.

The report of the Committee on Constitution and By-Laws was read by Mr. Charles W. Deusner, Chairman, and was finally adopted in the following form:

CONSTITUTION

ARTICLE I.

Name.

The name of this organization shall be THE MISSOURI BOTANICAL GARDEN ALUMNI ASSOCIATION.

ARTICLE II.

Object.

The object of this Association is to cultivate the spirit of fraternity among its members and to foster and strengthen the relationship between them and their Alma Mater.

ARTICLE III.

Membership.

Section 1. Active members shall be those who have received certificates of graduation from the regular Garden Course of the Missouri Botanical Garden, have expressed a desire for such membership, and have paid the regular dues.

Section 2. Associate members shall be those who have been enrolled as members of classes in the regular Garden Course of the Missouri Botanical Garden, but have not completed the course, have expressed a desire for such membership, and have paid the regular dues.

Section 3. Honorary members may be elected at any regular meeting.

ARTICLE IV.

Dues.

The annual dues for active members shall be one dollar and for associate members fifty cents. Voluntary contributions will be acceptable at all times.

ARTICLE V.

Deliberations and Franchise.

All members shall have equal privileges in the deliberations of the meetings, but the power of the vote shall be restricted to active members.

ARTICLE VI.

Officers.

Section 1. The officers of this Association shall be elected from the active members and shall consist of President, Vice-President, Secretary-Treasurer, Historian and Executive Board. The Executive Board to be composed of the first three officers above named.

Section 2. The duties of President, Vice-President, and Secretary-Treasurer shall be those usually devolving upon such officers.

Section 3. The duty of the Executive Board shall be to transact all business of the Association between regular meetings, subject to the approval of the Association at a later regular meeting.

Section 4. The duty of the Historian shall be to collect and preserve for record and future reference historical data pertaining to members of the Association and such data of the Missouri Botanical Garden as may have a bearing on this Association and its members.

Section 5. The officers of the Association shall be elected at a regular meeting, and shall continue in office until such time as their successors shall be duly elected.

ARTICLE VII.

Meetings.

The regular meetings of the Association shall be held at the Missouri Botanical Garden, St. Louis,—the date to be announced by the Executive Board. Call-meetings may be provided for by the Executive Board.

ARTICLE VIII.

Quorum.

A quorum shall consist of seven active members.

ARTICLE IX.

Rules of Order.

Where any point is not covered by the articles of this Constitution, Roberts' Rules of Order shall be the standard of the Association.

ARTICLE X.

Amendments.

This constitution may be amended at any regular meeting providing notice, together with the proposed amendment, has been mailed by the Executive Board to each active member at least one month prior to the regular meeting.

By-Laws

Order of Business.

1. Call to order.
2. Roll-call by the Secretary.
3. Report of Secretary for the last regular meeting.
4. Report from the Executive Board.
5. Unfinished business.
6. New business.
7. Election of honorary members.
8. Election of officers.
9. Good of the Association.
10. Adjournment.

The names of those elected to membership, with an indication of those present, follows:

ACTIVE

*Deusner, Charles W., '00, 4526 N. Paulina Street, Chicago, Ill.
*Erwin, Arthur T., '96, Iowa Ag. Ex. Station, Ames, Iowa.
*Fullgraf, Charles W., '04, Chemical Building, St. Louis, Mo.
*Gross, Arthur R., '01, Mount Greenwood Cem'y, Morgan Park, Chicago
*Nehrling, Arno H., '09, Agricultural College, Amherst, Mass.
*Nehrling, Bruno, '03, Highland Cemetery, South Bend, Ind.
*Nehrling, Walter H., '99, Eastern Illinois State Normal, Charleston, Ill.
*Ochs, Henry, '09, Anheuser-Busch Brewing Assn., St. Louis, Mo.
*Pfaender, Peter, '14, Washington University, St. Louis, Mo.
*Schulte, George D., '07, Oregon, Missouri.
*Smith, Arthur H., '11, Kemble Floral Company, Boone, Iowa.
*Sutermeister, Miss Eda A., '00, 423 Security Building, St. Louis, Mo.
*Winther, Cornelius, '00, Bellefontaine Cemetery, St. Louis, Mo.

ASSOCIATE

*Federer, William A., 3841 Wyoming Street, St. Louis, Mo.
*Giebel Carl, Missouri Botanical Garden, St. Louis, Mo.
*Gillies, Walter, 4312 De Soto Street, St. Louis, Mo.
*Grossart, Fred A., Missouri Botanical Garden, St. Louis, Mo.
*Tuggle, Jesse B., Park College, Parkville, Mo.

HONORARY

*Dr. George Thomas Moore, Missouri Bot. Garden, St. Louis, Mo.
Dr. Hermann von Schrenk, Missouri Bot. Garden, St. Louis, Mo.
*Dr Edward Angus Burt, Missouri Bot. Garden, St. Louis, Mo.
*Dr. Jacob Richard Schramm, Missouri Bot. Garden, St. Louis, Mo.
*Mr. Charles Henry Thompson, Missouri Bot. Garden, St. Louis, Mo.
*Mr. William Woodward Ohlweiler, Missouri Bot. Garden, St. Louis, Mo.
Mr. John Noyes, Missouri Bot. Garden, St. Louis, Mo.
*Mr. Julius Erdman, Missouri Bot. Garden, St. Louis, Mo.
*Mr. Konstantin Nicolaus Svetlikoff, Mo. Bot. Garden, St. Louis, Mo.
*Mr. Henry Michiel Biekart, Missouri Bot. Garden, St. Louis, Mo.
Mr. James Gurney, Sr., Tower Grove Park, St. Louis, Mo.
Dr. William Trelease, University of Illinois, Urbana, Ill.
*Mr. Henry C. Irish, Board of Education, St. Louis, Mo.
Dr. J. B. S. Norton, Maryland Ag. Ex. Station, College Park, Maryland
*Dr. John Charles Whitten, University of Missouri, Columbia, Mo.

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*Present at initial meeting.

THE DOVE ORCHID

Among the many plants indigenous to the moist regions of Central America, one of the most interesting is the dove, or Holy Ghost, orchid (*Peristeria elata*). This plant was first brought into cultivation in 1826, when Mr. Bernard, a Peruvian merchant, sent it to Mr. Harrison, of Liverpool, England, in whose orchid house it flowered for the first time in 1839. The Garden owes the addition of this orchid to its collection to Mr. Leonard Matthews, who successfully brought specimens from Panama, in 1889.

By the early Spanish settlers this plant was held sacred, much as was the lotus lily by the Egyptians, and was named by them "El Espiritu Santo," or Holy Ghost orchid.

The flower spikes attain a height of from three to six feet and bear a waxy, globose, and extremely fragrant flower about two inches in diameter. The sepals and petals are pure white, shielding the column. The latter with the anther cap, or cliandrium, forms the neck and head of the dove, while the rostellum, or abortive pistil, represents the beak. The wings are formed by the side lobes of the labellum, or large lower petal. The flower spike is produced from the base of the large ovate pseudo-bulbs, the latter being among the largest found in the orchids, varying in size from three to eight inches in length and three to four inches in width. The leaves, of which there are four or five to each bulb, are from two to three feet long and are prominently nerved or veined beneath. Instead of growing in the air, as do so many of this group, the Holy Ghost orchid has a terrestrial habit, and in the greenhouse is planted in a mixture of sod soil with peat and moss. Luxuriant growth is favored by keeping the plant in as nearly a saturated atmosphere as possible, whereas the reverse treatment is necessary to induce the plants to produce flowers. The plant which is on exhibition in the orchid house was forced to produce a flower spike by giving it a long rest in the cactus house, where the conditions are desert-like. After the flower spike appeared, the plant was returned to its former moist position, where the atmospheric conditions were more favorable for the further development of the flowers. The effect of this treatment is well illustrated in the two specimens now being shown in the greenhouse. The one which was subjected to the dry resting period has produced a fine flower spike, while the other, which was constantly kept under moist conditions, has produced new pseudo-bulb growth but no flowers.

In addition to the dove orchid, the following forms are at present in flower in the orchid house: *Angraecum Eichlerianum, Brassavola nodosa, B. venosa; Bulbophyllum Careyanum; Calanthe Veitchii; Cattleya Luddemanniana, C. Trianaei; Cymbidium sinense; Cypripedium acis, C. Adonis, C. Arthurianum, C. barbatum Crossii, C. callosum, C. calypso, C. Colmanii nigrum, C. Crossianum, C. Engelhardtae, C. Harrisianum* var. *tenue* and *luteum, C.* "Hero", *C. insigne* var. "Dorothy," "Harefield Hall," and *Sanderae, C. Leeanum, C. Macfarlanianum, C. pavonianum, C. Pitcherianum, C. Pollettianum, C.* "Pres. McKinley," *C. Spicerianum, C. tityus, C. Troilus, C. venustum; Dendrobium bigibbum, D. formosum giganteum, D. Phalaenopsis*

Schroederianum; Epidendrum densiflorum, D. elongatum, D. nocturnum, D. O'Brienianum, D. pentotis, D. polybulbon, and a species from Panama; *Laelia pumila praestans; Maxillaria variabilis lutea; Oncidium iridifolium, O. splendidum; Pleurothallus villosa,* and a species from Mexico; *Polystachya laxiflora, P. minuta;* and *Selenipedium Sedeni.*

NOTES

Mr. C. F. Giebel read a paper on "Tropical Insects" at the meeting of the Entomological Section of the Academy of Science, on December 9.

On December 21, Dr. Hermann von Schrenk, Pathologist to the Garden, addressed the Academy of Science of St. Louis on "The Modern Uses of Lumber."

On November 24, Mr. Hamilton and Mr. Coburn, respectively, General Manager and Principal Assistant Engineer of the Vandalia Railroad, were visitors at the Garden.

Dr. B. M. Duggar, Physiologist to the Garden, addressed the Gamma Alpha (Graduate) Fraternity, of the University of Illinois, on the occasion of their founder's day celebration.

Mr. C. H. Thompson, Assistant Botanist to the Garden, gave an illustrated talk on the Garden before the Girl's Self-Culture Club of the St. Louis Settlement Association on December 8.

Members of the Board of Regents of the University of Nebraska visited the Garden on December 9. A special guide escorted the party through the conservatories and outdoor collections.

Dr. J. R. Schramm, Assistant to the Director, spoke before the Indiana Apple Show, at Indianapolis, Indiana, on November 24. The subject of the address was, "The Apple Plant in Health and in Disease."

Mr. E. C. Ewing, Agronomist of the Mississippi Agricultural Experiment Station, visited the laboratory on December 18 and 19 in connection with his experimental work on ecological conditions and cotton production.

Mr. H. A. Gardener, Director of the Technical Laboratory of the National Paint Manufacturers' Association, of Washington, D. C., visited the Garden on November 20. Mr. Gardener was especially interested in the investigations being conducted by Dr. von Schrenk, Pathologist to the Garden, and his associates.

Dr. and Mrs. Forrest Shreve, of the Desert Laboratory of the Carnegie Institution of Washington, Tucson, Arizona, spent a day at the Garden, December 16. At a special seminar of staff and graduates, Dr. Shreve discussed the work on desert vegetation with especial reference to the quantitative study of environmental factors. Mrs. Shreve described the present status of her work in the measurement of leaf temperatures.

The Missouri Botanical Garden Students' Club, to which reference was made in the November BULLETIN, held its regular semi-monthly meetings in December. A paper by Mr. G. H. Pring on "The Garden Collection of Orchids" and one on "American Cultivation of Orchids" by Mr. N. S. Philippi constituted the program of the first meeting. At the second meeting Mr. E. J. Palmer, Collector to the Garden and the Arnold Arboretum, read a paper on "The Crataegus Problem." Other papers of the evening were, "Holiday Plants," by Mr. Julius Erdman, and "Bulbs and their Culture," by Mr. Andrew Cella. The club announces the following programs for January: January 7, "Twin Falls, Iowa," S. P. Jensen, and "Civic Improvement," Paul A. Kohl; January 21, "Landscape Opportunities in St. Louis," John Noyes, and "Effects Produced by Trees in Landscapes," Clarence Pedlow. The meetings of the club are held regularly on the first and third Thursdays of each month at 8:15 o'clock, in the graduate lecture room at Tower Grove and Botanical Avenues. All persons interested are cordially invited to attend the meetings.

STATISTICAL INFORMATION FOR NOVEMBER, 1914

Total number of visitors	**57,160**
PLANT ACCESSIONS:	
Total number of plants received in exchange	**199**
Total number of packets of seeds received in exchange	**18**
Total number of plants and seeds donated	**33**
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	**26**
Total number of books and pamphlets donated	**311**
HERBARIUM ACCESSIONS:	
By Purchase—	
A. O. Garrett—"Fungi Utahensis," Fascicle IX, Nos. 201-225	**25**
A. A. Heller—Plants of California	**225**
By Gift—	
J. Dearness—Specimens of *Thelephora*	**3**
J. A. Drushel—Flowering Plants of Alabama and Missouri	**12**
W. G. Farlow—Specimens of fungi from New England, Cuba, and Jamaica	**16**
H. D. House—Specimens of fungi from New York	**45**
C. J. Humphrey—Specimens of fungi from South Carolina	**3**
N. T. Peterson—Plants of the Southern States	**4**
Juan Z. Salazar—*Yucca guatemalensis* Baker from Mexico	**1**
H. E. Vasey—*Astragalus* from Nebraska	**2**
H. von Schrenk—Fungi from Illinois and Missouri	**4**
By Exchange—	
University of Pennsylvania—specimens of the *Scrophulariaceae*, mainly from the southeastern United States	**59**
By Field Work—	
Rev. John Davis—Plants of Missouri	**1,200**
J. M. Greenman and C. H. Thompson—Plants of Missouri	**209**
C. H. Thompson—Cultivated Plants	**527**
	2,335

The Garden is open to the public week days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission free. Beginning with the first Sunday in December and continuing until April 4, the Garden is closed Sundays.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

The Garden is closed all day on Christmas day and New Year's day.

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